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FOR GRADE XII

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UNIT

14

RESPIRATION

KEY CONCEPTS

Energy is the most important requirement of life. All systems require energy to w ork. The various processes carried out by body, such as movement, growth and reproduction, all require the expenditure of energy. In animals this energy can be obtained only from the food they eat. In the processes of cellular respiration this food energy is made available for the body activities. Aerobic respiration involves the use of oxygen and the production of carbon dioxide. Oxygen enters into animal's body from air or water surrounding it. In the less complex animals the oxygen is absorbed over the entire exposed surface of the body. In higher animals, however, there are special respiratory organs such as gills or lungs. Excess carbon dioxide is usually eliminated from the same organ.

14.1 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.

14.2 HUMAN RESPIRATORY SYSTEM

Respiratory system provides the fundamental ability to breath. This system consists of nose and nasal cavities, pharynx, larynx, trachea, bronchi, bronchioles, and alveoli in the lungs.

14.2.1 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.

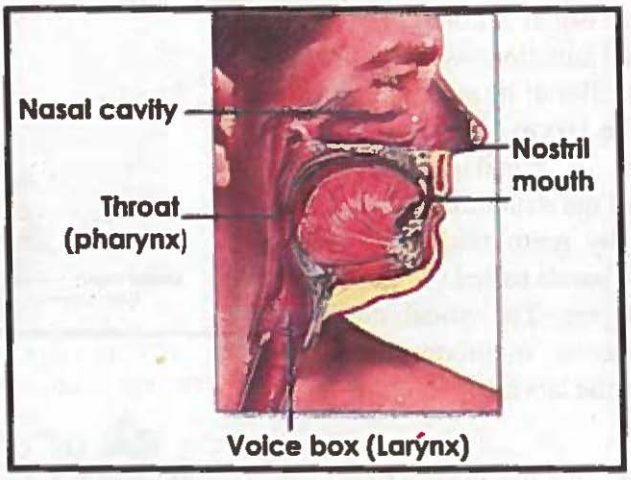


Fig:14.1 Nasal passage through face

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. Underneath the mucous membrane, there are blood capillaries that help to warm the air to about 30 °C, depending upon the external temperature.

14.2.2 Pharynx

Pharynx is cone-shaped passageway leading from the oral and nasal cavities to the oesophagus and larynx. The pharynx is part of both the digestive and respiratory systems.

For Your Information

The interconnection of the oral and nasal regions is extremely beneficial in humans. It allows them to breathe through either the nose or the mouth and, when medically necessary, allows food to be passed to the esophagus by nasal tubes.

14.2.3 Larynx

Larynx is an organ of complex structure that serves as a dual function: as an air canal to the lungs and controller of its access, and as the organ of voice. The **larynx** is composed of an external skeleton of cartilage plates that prevents collapse of the structure. The plates are fastened together by membranes and muscle fibers. Two fibrous bands called vocal cords are located in the larynx. The vocal cords are composed of mucous membrane stretched horizontally across the larynx.

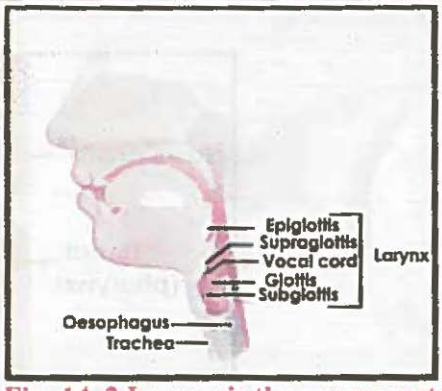


Fig: 14. 2 Larynx is the upper part of the respiratory system.

14.2.4 Trachea

Below the larynx lies the trachea, a tube of 10 to 12 cm long and 2cm wide. Its wall is stiffened by 16 to 20 characteristic horse shoe shape incomplete rings that open towards the back and are embedded in a dense connective tissue.Trachea is lined with ciliated mucus membrane. The trachea serves as passage for air, moistens and warms it while it passes into the lungs, and protects therespiratory surface from an accumulation of foreign particles.

tidbit

Men and women have different vocal cord sizes. This difference in size causes a difference in vocal pitch. Adult males have larger cords and usually low pitched voices.

14.2.5 Bronchi

The trachea divides into two stem bronchi, one each for the left and right lung. The right bronchus has a larger diameter, and is shorter than the left bronchus. Structure of bronchi closely resembles that of the trachea; however they have small cartilaginous plates to support their walls. The bronchi divide and re-divide forming an air way network in the lungs.

Skills

Analyzing and Communicating

Draw and label a diagram to illustrate microscopic features of human lung with the help of slides.

14.2.6 Bronchioles

The bronchioles are located at the end of the bronchi and terminate in the alveoli. The bronchioles are approximately 1mm or less in diameter and their walls consist of ciliated cuboidal epithelium and a layer of smooth muscle.

The bronchioles are the first airway branches that do not contain cartilage. They are responsible for controlling air distribution in the lungs. The bronchioles change diameter to either increase or reduce air flow. The bronchioles continue to divide and subdivide deep into the lungs. Eventually the terminal bronchioles open into small collections of air sacs known as alveoli, where the actual exchange of carbon dioxide and oxygen occur.

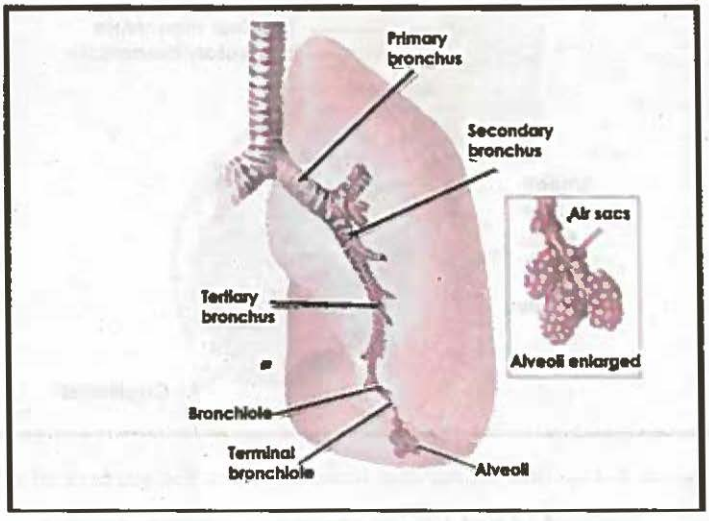


Fig:14.3 Branching of trachea leads to a netwok of airway passages.

14.2.7 Alveoli

The alveoli form the gas exchange surface. The wall of each alveolus is only 0.1 μm thick. On its outsides is a dense network of blood capillaries. Lining each alveolus is moist squamous epithelium.

tidbit

There are over 700 million alveoli present in the lungs, representing a total surface area of 70-90m.

This consists of very thin, flattened cells, reducing the distance over which diffusion must occur. Collagen and elastic fibres are also present which allow the alveoli to expand and recoil easily during breathing.

14.2.8 Lungs

Human have two lungs, a right and a left, which are located in the thoracic cavity. Together, the lungs occupy most of the intra thoracic space. The

right and left lungs are slightly unequal in size. The right lung represents 56% of the total lung volume and is composed of three lobes, a superior, middle, and inferior lobe. The left lung, smaller in volume because of the asymmetrical position of the heart, has only two lobes. In the thorax the two lungs rest with their bases on the diaphragm, while their apexes extend above the first rib.

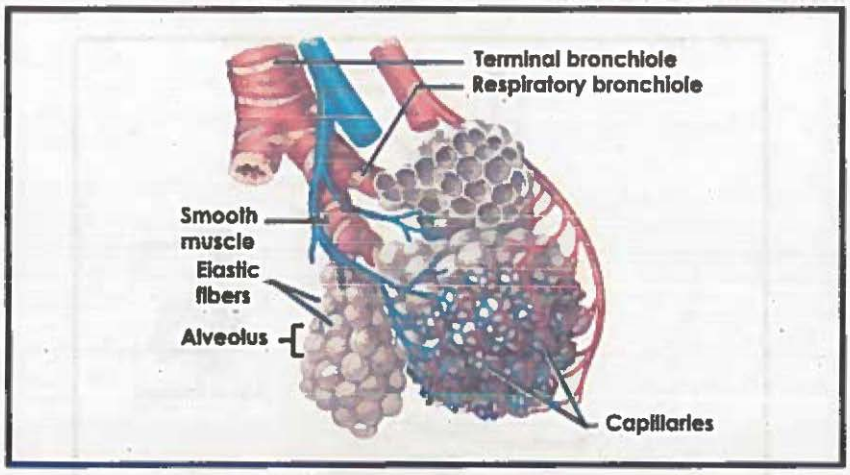


Fig:14.4 Capillaries form a network over the surface of alveoli.

Skills

(Analyzing and Interpreting)

Trace the path of air through different parts of human respiratory tract.

For Your Information

Special cells in the alveolus wall secrete a detergent like chemical on to the inside lining of the alveolus. This is called a surfactant. It lowers the surface tension of the fluid layer lining the alveolus, and thereby reduces the amount of effort needed to breathe in and inflate the lungs. Surfactants also help to kill any bacteria which reach the alveoli.

Each lung is encased in a thin membranous sac called the pleura. It consists of two tough, flexible, transparent pleural membranes. These protect the lungs, stop them leaking air into the thoracic cavity and reduce friction between the lungs and the wall of the thorax.

14.3 LUNG VOLUMES AND CAPACITIES

Lung volumes and lung capacities refer to the volume of air associated with different phases of the respiratory cycle. The average adult human has a lung capacity of approximately 5 liters but only a small amount of this capacity is used during normal breathing.

- Tidal volume is the volume of air exchanged during one breath in and out in quiet breathing. This is about 500 ml
- Residual volume is the volume of air remaining in the lungs even after a forcible expiration. This is about 1.5 liter.

14.4 CONTROL OF BREATHING

Normally breathing is an involuntary process and is not controlled consciously. However, some voluntary control is also possible.

14.4.1 Involuntary control

Involuntary control of breathing is carried out by a breathing centre located in the medulla oblongata. The ventral portion of the breathing centre acts to increase the rate and depth of inspiration and is called inspiratory centre. The dorsal and lateral portions inhibit inspiration and stimulate expiration and form the expiratory centre.

For Your Information

Oxygen concentration also has an effect on the breathing rate. However, under normal circumstances there is an abundance of oxygen available, and its influence is relatively minor. About 20% decrease in oxygen concentration in the air produce a doubling in breathing rate. Oxygen concentration also has an effect on the breathing rate. However, under normal circumstances there is an abundance of oxygen available, and its influence is relatively minor. About 20% decrease in oxygen concentration in the air produce a doubling in breathing rate.

Skills

(Analyzing and Interpreting)

Identify different parts of the respiratory system of a dissected frog (dissection would be done by the teacher).

The breathing centre communicates with the intercostal muscles by the intercostals nerves and with the diaphragm by the phrenic nerves. Rhythmic nerve impulses to the diaphragm and intercostal muscles bring about breathing movements. We know that breathing consists of two phases namely breathing in or inspiration and breathing out or expiration.

Inspiration (Inhalation)

In human, inspiration is an active process. During inspiration, the intercostal muscles between the ribs contract and pull the ribs forward and outward, pushing the sternum farther away from the vertebral column. By the contraction of the intercostal muscles and of the diaphragm the size of the thorax as a whole is increased and the pleural cavities within it are, therefore enlarged. Since the pleural cavities are closed, their enlargement tends to create a partial vacuum within them. The lungs are elastic and communicate with the atmosphere through the air passages (trachea, bronchi). As soon as the pressure around the lungs is lowered, the air rushes into them through the trachea by its own pressure and dilated them. In this way the lungs expand to fill the pleural cavities and the pressure on the inside and outside of the thorax are equalized. Thus the mechanism of human breathing is a suction –pump mechanism. The lungs are made to expand and contract by movements of the ribs and diaphragm.

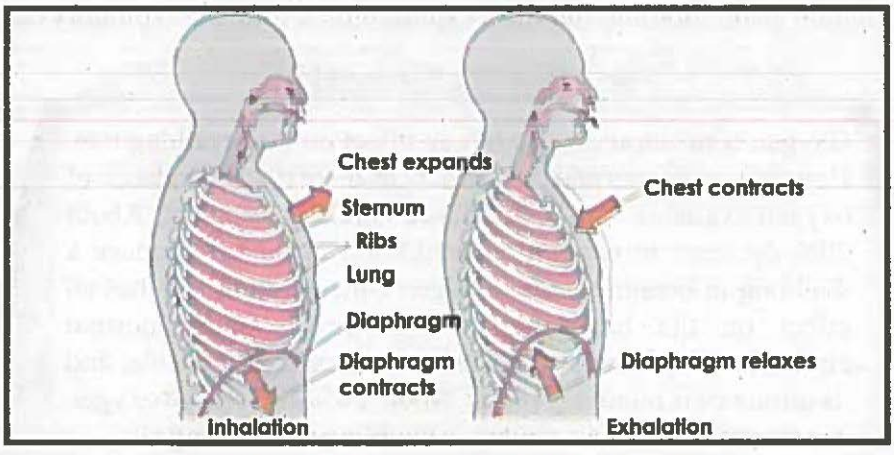


Fig:14.5 Inhalation and exhalation mechanism.

Expiration (Exhalation)

Expiration in human is normally passive. In severe muscular exercise however, the expiration also becomes active. During expiration, the intercostal muscles of the ribs relax, the ribs move down ward and inward. Thus the size of the chest cavity is reduced from side to side. The sternum comes to its original position, decreasing the size of the chest cavity from front to back or dorso –ventrally. At the same time muscles of the diaphragm relax and so the diaphragm assumes its dome shaped position. Thus the relaxation of the muscles of diaphragm and of the intercostals muscles the size of the thorax as a whole is decreased and the pleural cavities within are, therefore, reduced. This reduction in the size of the thorax exerts pressure on the lungs. The lungs themselves are very elastic and tend to return to their original size. When the lungs are pressed, the foul air inside them is expelled or expiration occurs.

14.4.2 Voluntary control

Within limits, the rate and depth of breathing are also under voluntary control as is evident by the ability to hold the breath. Voluntary control is also used during forced breathing, speech, singing, sneezing and coughing. During voluntary control impulses originate from the cerebral hemispheres and pass to the breathing centre.

14.5 MECHANISM OF TRANSPORT OF GASES

Like other materials, respiratory gases are also transported in various regions of the body by means of blood. The blood transports oxygen from the lungs to different tissues and carbon dioxides from tissues to the lungs.

14.5.1 Transport of oxygen in blood:

Approximately 97% of oxygen is carried by the red blood cells as **oxyhaemoglobin**, while 3% is transported as dissolved oxygen in the **plasma**.

At high partial pressure of 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.

$$Hb + 4O_2 \xrightarrow{\text{Carbonic anhydrase}} Hb4O_2$$

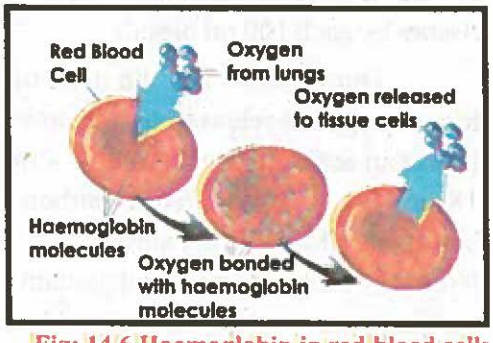


Fig: 14.6 Haemoglobin in red blood cells carry oxygen in the blood.

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 ml of blood (100% saturated) which is achieved at 100 mmHg PO_2.

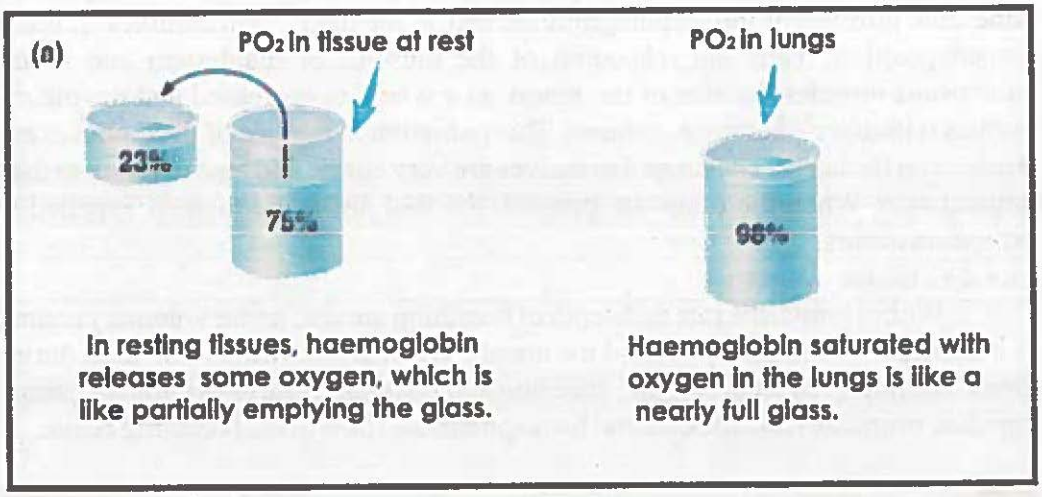


Fig: 14.7

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.

During exercise, the need of oxygen is greatly increased in the tissues so more oxygen is released by the arterial blood to the tissues. The venous blood that leaves an active tissue has only 4.4 ml O_2 per 100 ml of blood (20% saturated; PO_2 is 18 mmHg). Compared to carbon dioxide, oxygen is relatively insoluble in the blood, therefore a small amount of O_2 is transported in dissolved state in the plasma. Normally each 100 ml blood contain 0.29 ml O_2 (PO_2 is 95 mmHg) and this capacity may increase up to 0.3 ml/100 ml blood at 100 mmHg PO_2.

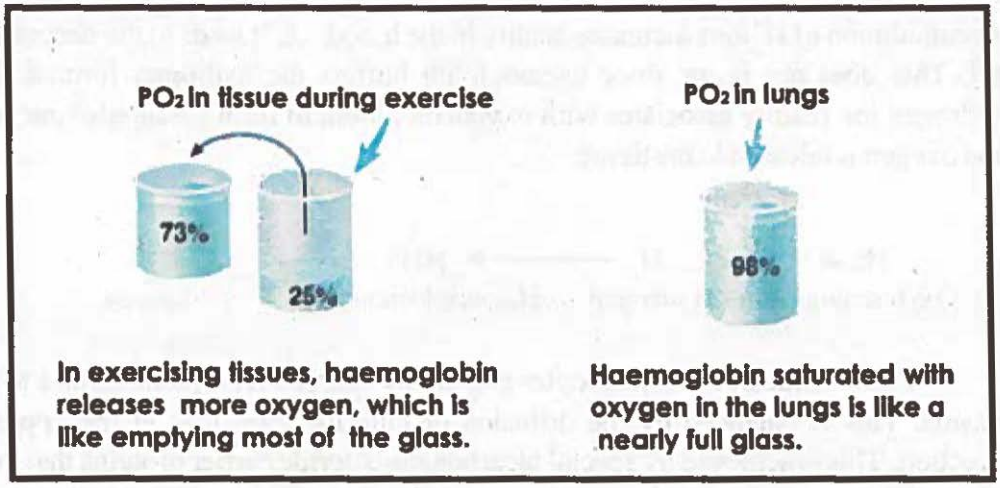


Fig: 14. 8

While the 100 ml of venous blood has 0.12 ml of dissolved O_2 (PO_2 is 40 mmHg). Thus, 0.17 ml of O_2 is transported by each 100 ml blood through the tissues per cycle in the dissolved state.

14.5.2 Transport of Carbon dioxide:

Carbon dioxide is transported in the blood in three main ways i.e. in the form of bicarbonate ions, in the form of carboxyhaemoglobin and 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 combines with water to form carbonic acid in the presence of enzyme carbonic anhydrase. The chemical reaction can be depicted as follows:

$$CO_2 + H_2O \underset{\text{Carbonic anhydrase}}{\rightleftharpoons} H_2CO_3$$

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

$$H_2CO_3 \underset{\text{Carbonic anhydrase}}{\rightleftharpoons} H^+ + HCO_3^-$$

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 to form haemoglobinic acid and oxygen is released to the tissue.

$$\underset{\text{Oxyhaemoglobin}}{Hb.4O_2} + \underset{\text{Hydrogen}}{H^+} \longrightarrow \underset{\text{Haemoglobinic acid}}{HHb} + \underset{\text{Oxgen}}{4O_2}$$

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 **Hamburger's phenomenon.**

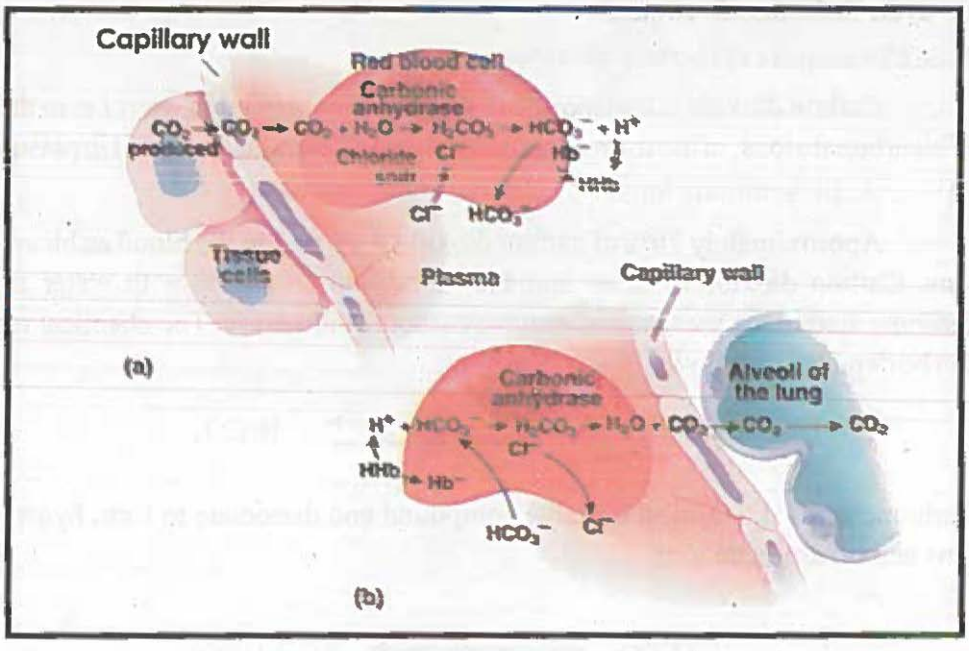


Fig: 14. 9 Mechanism of transport of carbondioxide.

The chloride ions that enters the RBC combine with potassium (K+) to form potassium chloride, whereas bicarbonate ions in the blood plasma combines with Na+ to form sodium bicarbonates.

Skills
(Initiating and Planning)

Examine some sheep's lungs obtained from butcher's shop.

For Your Information

All vertebrates use the haemoglobin as respiratory pigment that transports gases in the body, whereas invertebrates have respiratory pigments 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 haemocyanin is blue in color, deoxygenated is almost colourless. Oxygenated chlorocruorin turns green where oxygenated haemoerythrin is a violet to pink colour, and colourless when deoxygenated. **Do you think why human blood is of red colour?** In colored diagrams of human circulatory system, venous blood is generally represented by blue color. **Do you think our venous blood is really of blue color?**

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 above. 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 Carbaminohaemoglobin:

About 23% of carbon dioxide is carried as carbaminohaemoglobin. CO2 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 carbaminohaemoglobin occurs. When the PCO_2 is higher in the blood than tissues as in case of lungs, carbaminohaemoglobin releases its CO_2

(iii) As dissolved CO_2 in plasma:

Only 7% of carbon dioxide is carried this way. This is rather inefficient way to carry carbon dioxide, but it does occur.

14.6 RESPIRATORY PIGMENTS

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.

14.6.1 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.

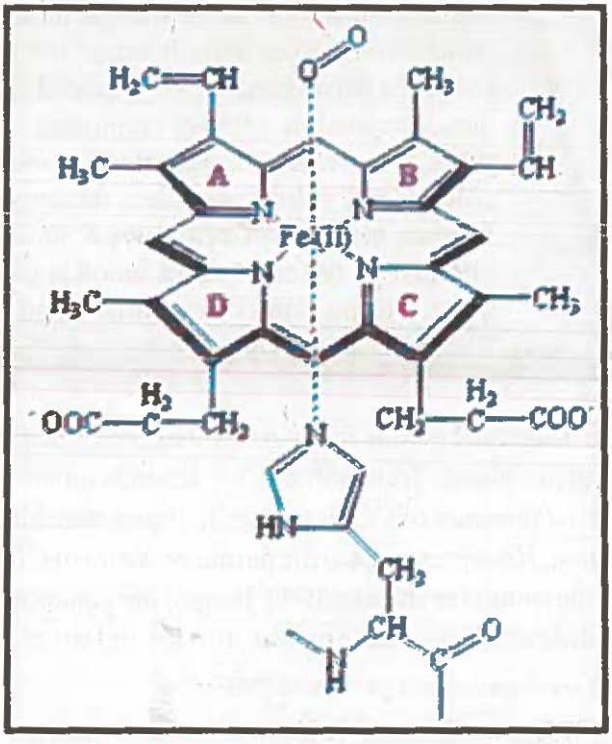


Fig: 14.10 Chemical structure of haeme group is haemoglobin

14.6.2 Myoglobin

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

Fig:14. 11 Myoglobin

14.7 RESPIRATORY DISORDERS

Whenever respiratory tract is exposed to an unhealthy atmosphere, it is likely to become infected by various organisms. The infections may occur in upper as well as in lower respiratory tract. Most common problems of upper and lower respiratory tract are given below.

Upper Respiratory Disorders

14.7.1 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. There are four large sinuses: two inside the cheekbones (the maxillary sinuses) and two above the eyes (the frontal sinuses). The sinuses are lined with membranes that secrete antibody-containing mucus, which protects the respiratory passages from the irritants in the air we breathe.

Causes and Risk Factors of Sinusitis

It is usually caused by infection (bacterial or viral), but can also be caused by allergic reactions dust, pollen etc. Environmental agents, such as excessive dryness in homes and offices from dry-air heating and air-conditioning systems can also inflame the sinuses.

Symptoms of Sinusitis

The classic symptoms of acute (short lasting) sinusitis are:

- fever
- nasal obstruction

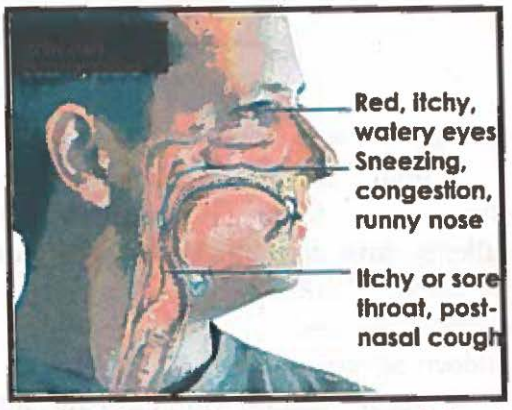


Fig:14. 12 Some of the symptoms of sinusitis

- pus-like (purulent) nasal discharge
- loss of sense of smell
- facial pain or headache
- Entering of nasal fluid into pharynx)

Treatment of Sinusitis

If a bacterial infection is present, antibiotics, or sulfa drugs, are usually prescribed.

Antiallergic and decongestants are also used for treatment of sinusitis.

14.7.2 Otitis Media

Otitis media is an inflammation of the middle ear. The eustachian tubes equalize the pressure between the middle ear cavity and the outside mucus to drain out of the middle ear cavity.

Inflammation of the middle ear causes the tubes to close causing the fluid to become trapped. Bacteria travel from the back of the nose through the fluid in the eustachian tube directly into the middle ear cavity and multiply in the fluid.

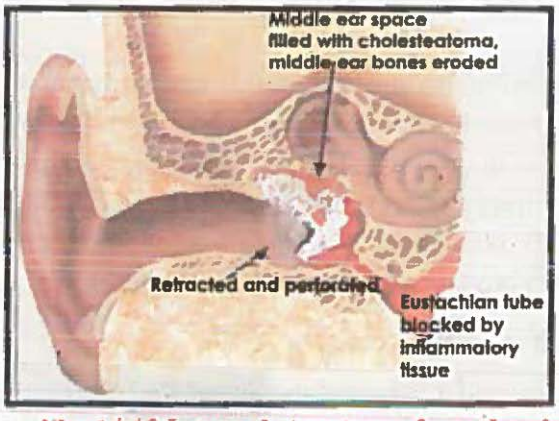


Fig: 14.13 Internal structure of ear showing region of middle ear.

Causes and Risk Factors of Otitis Media

Children are more commonly affected than adults because of the small size and horizontal position of their eustachian tube. The four main causes of otitis media are allergy, infection, blockage of the eustachian tube and nutritional deficiency.

Symptoms of Otitis Media

Otitis media causes

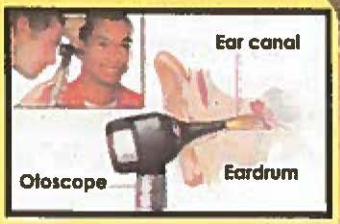
- sudden, severe earache
- deafness, and tinnitus (ringing or buzzing in the ear)
- sense of fullness in the ear
- irritability

- fever, headache, a change in appetite or sleeping patterns
- fluid leaking from the ear, nausea
- difficulty in speaking and hearing

Occasionally, the eardrum can burst, which causes a discharge of pus and relief of pain.

For Your Information

An Otoscope or auriscope is a medical device which is used to look into the ears. Otoscope consists of a light source and a simple low-power magnifying lens.



Treatment of Otitis Media

Around 80% of cases of 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, following treatment options may be taken into consideration.

- Antibiotics may be prescribed to treat severe cases of middle ear infection or cases that get worse after two or three days.
- Painkillers, may be used to control the main symptoms of middle ear infection (pain and fever).

For Your Information

For children with recurrent, severe middle ear infections, tiny tubes may be inserted through the eardrum to help drain fluid. These tubes are called grommets or tympanostomy tubes.Sometime a small hole is made in the eardrum surgically to allow fluid to drain out. This surgical operation is called myringotomy

Lower Respiratory track Infections

14.7.3 Pneumonia

Pneumonia is a serious disorder of lower respiratory tract which is characterized by inflammation of alveolar wall and the 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 bacterial infection (including mycoplasma) and viruses, which can enter the body 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 pneumonia*, *Hemophilus influenzae*, *Legionella pneumophilia*, *Staphylococcus aureus*, and *Mycoplasma*.

If pneumonia is not treated timely, some complications may arise that include pleural 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
- 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 pneumonia, the person may experience violent coughing

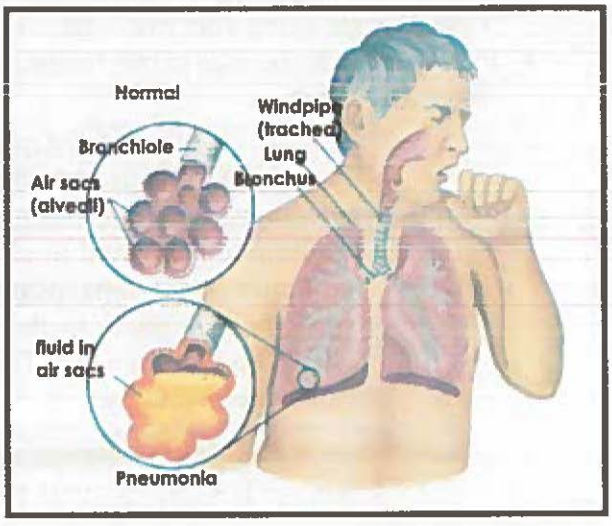


Fig: 14.14 In pneumonia body is unable to get proper amount of oxygen due to Fluid in the air sacs.

attacks, 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.

14.7.4 Tuberculosis

Tuberculosis (TB) is a highly contagious chronic bacterial infection of lungs. TB infection begins when the mycobacteria reach the alveoli, where they invade and replicate within the phagosomes (vacuole formed as a result of phagocytosis) of alveolar macrophages, but they are unable to digest the bacterium.

Causes:

TB is caused by the *Mycobacterium tuberculosis* that is transmitted from person to person by airborne droplets. Usually this infection is passed on as a result of very close contact, so family members of an infected person are in dangered if the person continues to live in the same household and has not undergone proper treatment.

tidbit

About 15 percent of TB patients may develop the disease in an organ other than the lung, such as the lymph nodes, GI tract, bones and joints.

Risk factors for TB include the following:

HIV infection, low socioeconomic status, alcoholism, homelessness, crowded living conditions, diseases that weaken the immune system, migration from a country with a high number of cases, and health-care workers.

Symptoms of Tuberculosis

You may not notice any symptoms of illness until the disease is quite advanced. Loss of weight, loss of energy, poor appetite, fever, a productive cough, and night sweats -- might easily be blamed on another disease.Only about 10% of people infected with *M. tuberculosis* ever develop tuberculosis disease. Many of those who suffer TB do so in the first few years following infection, but the bacillus may lie dormant in the body for decades.

Treatment of Tuberculosis

Tuberculosis can be cured by a course of antibiotics taken over several months. Isoniazid and rifampin are the most common drugs used for TB. Inexpensive, effective and easy to take, these can prevent most cases of TB.

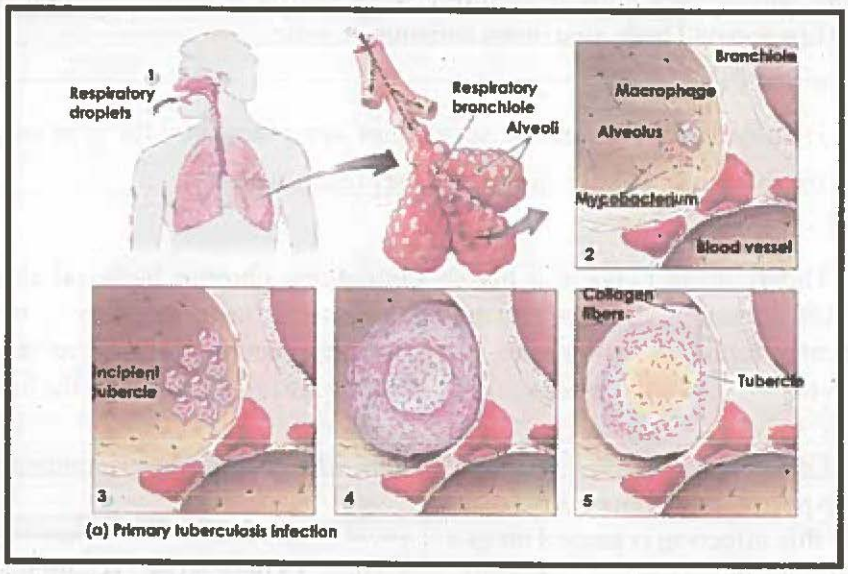


Fig: 14.15 Steps in the primary tuberculosis infection.

The disease can also be prevented by:

1) Vaccinating infants with BCG vaccine.
2) Isolating infectious patients.
3) Improving hygienic condition and housing.
4) Using pasteurized and properly boiled milk.

14.8 Disorders of Lungs

14.8.1 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.

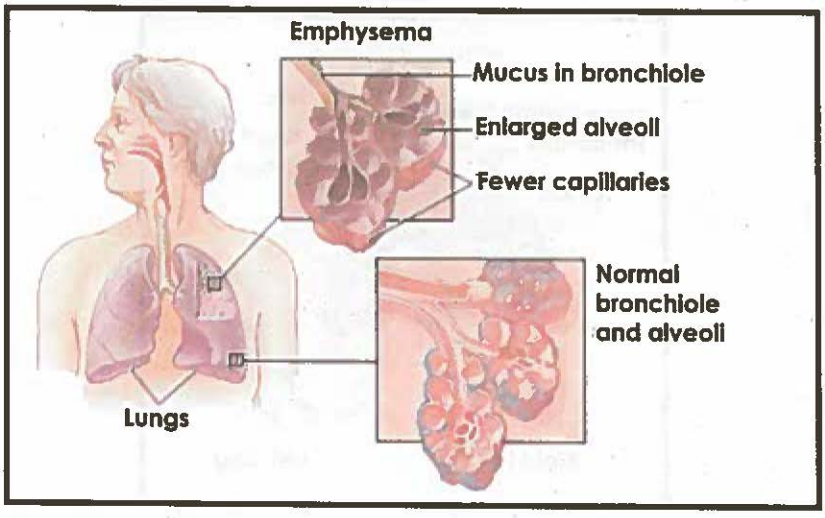


Fig: 4.16 Emphysema results in damaging the bronchiole and alveoli.

14.8.2 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 cancers. 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.

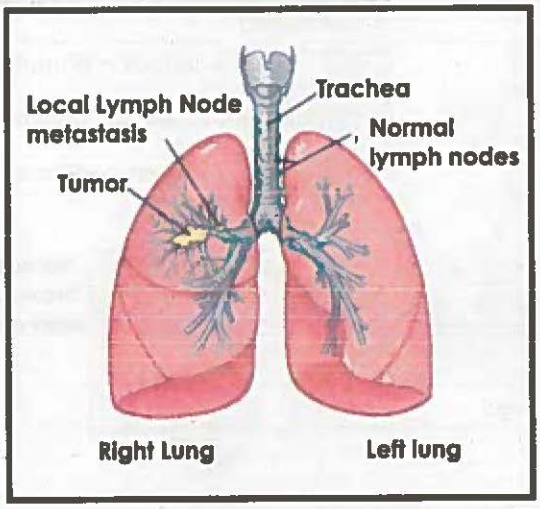
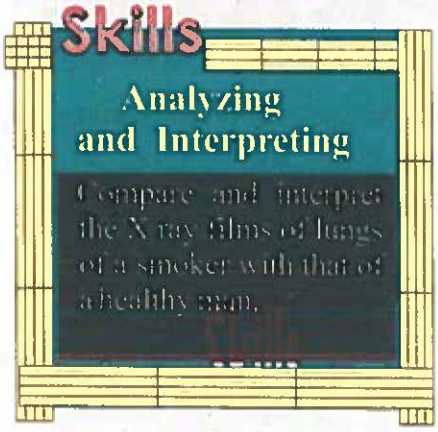


Fig: 4.17 Tumor in the lungs can develop at any place causing lung cancer.

14.8.3 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.



KEY POINTS

- For effective diffusion the respiratory surface must be permeable, thin, possess a large surface area with good blood supply and good ventilation mechanism to maintain a steep diffusion gradient across the respiratory surface.
- Respiratory system consists of nose and nasal cavities, pharynx, larynx, trachea, bronchi, bronchioles, and alveoli in the lungs.
- Lung volumes and lung capacities refer to the volume of air associated with different phases of the respiratory cycle.
- Normally breathing is an involuntary process and is not controlled consciously. However, some voluntary control is also possible. During voluntary control impulses originate from the cerebral hemispheres and pass to the breathing centre.
- Breathing consists of two phases namely breathing in or inspiration and breathing out or expiration.
- The blood transports oxygen from the lungs to different tissues and carbon dioxides from tissues to the lungs. Approximately 97% of oxygen is carried by the red blood cells as oxyhaemoglobin, while 3% is transported as dissolved oxygen in the plasma.
- Carbon dioxide is transported in the blood in three main ways i.e. in the form of bicarbonate ions, in the form of carboxyhaemoglobin and dissolved in plasma.
- Approximately 70% of carbon dioxide is carried in the blood as bicarbonate ions.
- About 23% of carbon dioxide is carried as carboxyhaemoglobin
- Only 7% of carbon dioxide by the plasma.
- In human, haemoglobin that increases the oxygen-carrying capacity of the blood and myoglobin that stores oxygen in muscles are referred as respiratory pigments.

KEY POINTS

- Sinusitis is an inflammation of the nasal sinuses and it is usually caused by infection (bacterial or viral), but can also be caused by allergic reactions dust, pollen etc.
- Otitis media is an inflammation of the middle ear.
- Pneumonia is a serious disorder of lower respiratory tract which is characterized by inflammation of alveolar wall and the presence of fluid and pus in alveolar sacs of one or both lungs.
- Tuberculosis begins when the mycobacteria reach the alveoli, where they invade and replicate within the phagosomes of alveolar macrophages, but they are unable to digest the bacterium.
- Emphysema is a lung disease in which the alveoli are damaged. It is generally caused by cigarette smoking or long-term exposure to certain industrial pollutants or dust.
- Lung cancer grows and spreads in different ways and its treatment depends on the stage, or how advanced it is. Treatment may include chemotherapy, radiation and surgery.

EXERCISE

1. Multiple Choice Questions

i. ***The wall of the trachea (windpipe) and bronchi of man is furnished with a series of incomplete:***

(a) cartilaginous plates (b) chitinous rings
(c) cartilaginous rings (d) muscular rings

ii. ***What does not happen during inspiration in man?***

(a) intercostals muscles contract (b) ribs are elevated
(c) diaphragm becomes dome-shaped (d) ribs move forwards

iii. ***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 & diaphragm

iv. ***When the human blood leaves the capillary bed of the tissue, most of the carbon dioxide is in the form of:***

(a) carbonic acid (b) bicarbonate ions
(c) carboxylic acid (d) none of them

v. ***Which sequence of organs is correct in air passageway of man?***

(a) nasal cavities larynx pharynx trachea bronchi
(b) nasal cavities pharynx trachea larynx bronchi
(c) nasal cavities pharynx larynx bronchi trachea
(d) nasal cavities pharynx larynx trachea bronchi

vi. ***Which part of the air passage way possesses cartilage plates in its wall?***

(a) bronchioles (b) distal region of bronchi
(c) proximal region of bronchi (d) trachea

vii. ***Human lungs are spongy due to the presence of million of:***

(a) bronchi (b) alveoli
(c) bronchioles (d) trachea

EXERCISE ?

viii. ***Which event is not associated with the activity of expiration?***

(a) contraction of diaphragm

(b) more dome like shape of diaphragm

(c) back ward & down ward movement of rib cage

(d) relaxation of intercostals muscles

ix. ***Oxygen carrying capacity of blood does not depend upon:***

(a) partial pressure of CO_2 (b) partial pressure of O_2

(c) height from sea level (d) quantity of blood

x. ***When haemoglobin of the blood is fully saturated with oxygen, the 100cc ofblood contains.***

(a) 15cc of oxygen (b) 20cc of oxygen

(c) 25cc of oxygen (d) 10cc of oxygen

2. Short Questions

i. What are the risk factors and causes of TB?

ii. State the signs and symptoms of otitis media.

iii. List two differences between haemoglobin and myoglobin.

iv. Give any two factors that affect the oxygen carrying capacity of blood.

3. Long Questions

i. Describe the structure of human respiratory system.

ii. Describe the mechanism of breathing in man.

iii. Describe the role of respiratory pigments in transport and storage of respiratory gases.

iv. State the causes, symptoms, and treatment of any one disorder of lower respiratory tract.

4. Science, Technology, and Society Connections

- Describe the development and working of artificial breathing apparatus (for use under water and at high altitude and by fireman)
- Justify why birds perform much better than man at high altitude.

EXERCISE ?

- Describe the purpose of mouth to mouth method for artificial respiration in First Aid.
- Relate the transportation of gases to hiccup, sneezing, and snoring.
- Describe the carbon monoxide poisoning (caused by gas heaters left on over-night in close environment).

Online Learning

- www.abc-of-yoga.com
- www.studentnurseconnections.com
- www.normalbreathing.com
- www.neok12.com/Respiratory-System
- www.cliffsnotes.com/.../Human-Respiratory-System