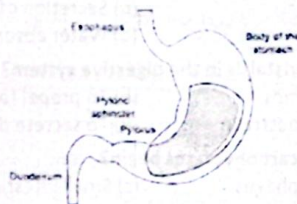


ENTRANCE TEST

MCQs (UHS)

- Oxyntic cells in stomach produce:
 - Pepsin
 - Gastrin
 - Pepsinogen
 - HCl
- The hormone which inhibits the secretion of gastric juice is:
 - secretin
 - thyroxin
 - Gastrin
 - Parathormone
- Trypsinogen is activated to trypsin by:
 - HCl
 - Mucus
 - Enterokinase
 - Gastrin
- The emulsification of fats is the role of:
 - Saliva
 - Gastrin
 - Pancreatic juice
 - Bile
- Digestion of _____ starts in oral cavity due to the action of enzyme present in saliva.
 - Starch
 - Fatty acids
 - Cellulose
 - Polypeptides
- Food enters from stomach into small intestine through:
 - Pyloric sphincter
 - Semilunar valve
 - Cardiac sphincter
 - Diaphragm
- _____ are the part of gastric gland which produce hydrochloric acid.
 - Parietal cells
 - Chief cells
 - Goblet cells
 - Zymogen cells
- Protein components of food are digested by the enzymatic secretion of:
 - Goblet cells
 - Zymogen cells
 - Parietal cells
 - Oxyntic cells
- Digestive system consists of different layers, the innermost is known as:
 - Submucosa
 - Muscularis
 - Mucosa
 - Serosa
- Food is diverted into the esophagus by:
 - Glottis
 - Cheeks
 - Tongue
 - Epiglottis
- Label 'a' in the following diagram:



- Cardiac sphincter
- Stomach valve
- Sinoatrial valve
- Pyloric sphincter

12. Enzyme pepsin acts on:

Options	Substrate	Product
A.	Proteins	Polypeptides
B.	Polypeptide	Dipeptides
C.	Fats	Fatty acids / glycerol
D.	Proteins	Amino acids

- The term "Loss of appetite" refers to disease:
 - Botulism
 - Obesity
 - Anorexia nervosa
 - Bulimia nervosa
- Salivary Amylase begins to digest Starch to shorter polysaccharides and then to:
 - Glucose
 - Sucrose
 - Maltose
 - Lactose
- Number of salivary glands found in human oral cavity:
 - 4
 - 6
 - 3
 - 2
- The first part of the large Intestine is:
 - Colon
 - Caecum
 - Appendix
 - Rectum

ANSWERS KEY

1. D	2. A	3. A	4. D	5. A	6. A	7. A	8. B	9. C	10. C	11. D	12. D
13. C	14. C	15. B	16. B								

Chapter

10

HUMAN RESPIRATORY SYSTEM

Student Learning Outcomes (SLOs)

After studying this chapter, the students will be able to:

- Define the respiratory surface and list its properties
- Describe the main structural features and functions of the components of human respiratory system.
- Explain the ventilation mechanism in humans.
- Describe the transport of oxygen and carbon dioxide through blood
- Outline the role of respiratory pigments.
- State the causes, symptoms and treatment of upper Respiratory Tract Infections (sinusitis, otitis media) and lower Respiratory Tract Infections (pneumonia, pulmonary tuberculosis).
- Describe the disorders of lungs (emphysema and COPD).

- You have studied in your previous class how organisms get energy out of food molecules.
- For the purpose to get energy, organisms carry out **catabolic processes** in their cells, collectively called cellular respiration (glycolysis, Krebs cycle, and electron transport chain).
- These processes use **oxygen** and produce carbon dioxide.

Recalling

- Our cells obtain oxygen from the blood. The blood obtains this oxygen from air present in our lungs.
- Oxygen diffuses across the wet membranes of the lungs, which are filled with air in the process of breathing.

External Respirations:

- The term external respiration is used for the **uptake of oxygen** from the environment and the **disposal of carbon dioxide** into the **environment** at the body system level.
- It involves breathing and the exchange of oxygen and carbon dioxide in the capillaries. The organs which carry out these processes constitute the respiratory system.
- The **theme of this chapter** is to explain the respiratory system of humans and important respiratory disorders.

RESPIRATORY SYSTEM OF MAN

- It consists of the organs that carry out **external respiration** (uptake of oxygen and disposal of carbon dioxide) at the body system level.
- Lungs as Respiratory System:** The main organs of respiratory systems are the lungs which provide suitable respiratory surface for this gaseous exchange in terrestrial habitat.
- Properties of the Respiratory Surface:**
 - Respiratory surface:** The area where actual gas exchange occurs between the environment and the blood is called respiratory surface. This gaseous exchange occurs through diffusion. In humans and other **vertebrates which breathe in air**, oxygen from the air diffuses into the blood and carbon dioxide diffuses from the blood to air.
 - The following properties enable respiratory surfaces for **effective** diffusion of gases across them.

- (i) **Moist and Permeable:** So that gases may pass through it.
- (ii) **Thinness:** So that gases have to travel minimum distance.
- (iii) **Rich Blood Supply:** So that gases can diffuse in and out of blood.
- (iv) **Great Structural Support:** So that it remains open and does not collapse.
- (v) **Located internally:** So that its moist surface does not lose water to the atmosphere.
- (vi) **Air Ventilates Over it:** Moves towards and away from it.
- (vii) **Air reaches to it after passing a branched tubular way -** so that air becomes saturated with water vapour before reaching it.

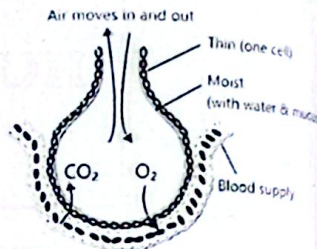


Figure: Some properties of respiratory surface

Components of Human Respiratory System:

- **Respiratory Tract:** The organs of the respiratory system form a continuous system of passages, called the respiratory tract, through which air flows into and out of the body.

Divisions of Respiratory Tract:

- The respiratory tract has two major divisions:
 - (1) The Upper Respiratory Tract
 - (2) Lower Respiratory Tract

(1) Upper Respiratory Tract (URT):

- It consists of:
 - (a) Nasal Cavity
 - (b) Pharynx
 - (c) Larynx
- These organs are involved in the movement of air into and out of the body.
- They also clean, humidify, and warm the incoming air.
- **Note:** No gas exchange occurs in these organs.

(a) Nasal cavity

- **Nostrils:** The external openings of nose, called nostrils.
- **Nasal Cavity:** The nostrils lead to a nasal cavity, it is a large, air-filled space behind the nose and partitioned by a nasal septum (a part of the nasal bone). As inhaled air flows through the nasal cavity, it is warmed and humidified by blood vessels present very close to its surface.

Functions of Nasal Cavity:

- **Hair + Mucus:** Hairs in the nose and produced by mucous membranes trap larger foreign particles in the air before they go deeper into the respiratory tract. In addition to its respiratory functions, the nasal cavity also contains chemoreceptors needed for sense of smell, and contribution to the sense of taste.

(b) Pharynx:

- It is a tube-like structure that connects the nasal cavity and oral cavity to larynx and oesophagus. Both air and food pass through it. So, it is part of both the respiratory and the digestive systems.
- Air passes from the nasal cavity through the pharynx to the larynx (as well as in the opposite direction). Food passes from the mouth through the pharynx to the esophagus.

(c) Larynx:

- The larynx connects the pharynx and trachea. It is composed of muscles and cartilages.

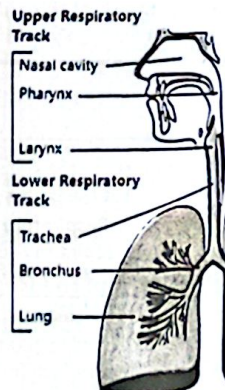


Figure: Respiratory track

Check Understanding!

1. Which feature of a respiratory surface directly enhances the rate of gas exchange by minimizing the distance gases must diffuse?

A. Moisture B. Thinness
C. Rich blood supply D. Internal location

- **Acts as Voice Box:** It is also called the **voice box**, because it contains two bands of smooth muscles called **vocal cords**. The vocal cords vibrate when air flows over them and so produce sound.
- **Epiglottis + Glottis:** It is a cartilaginous flap that extends in front and above the opening of **larynx** called glottis.
- **Importance of Epiglottis:**
 - When air enters the **larynx**, the epiglottis keeps standing upwards to give way to air.
 - When we swallow something, the backward motion of the tongue **raises the larynx**. Due to it, the epiglottis is forced downwards to close the **glottis**.
- Epiglottis prevents **swallowed material** from entering the **larynx**.

- Muscles in the larynx move the vocal cords apart to allow breathing.
- Other muscles in the larynx move the vocal cords together to allow the production of vocal sounds.
- The latter muscles also control the pitch of sounds and help control their volume.

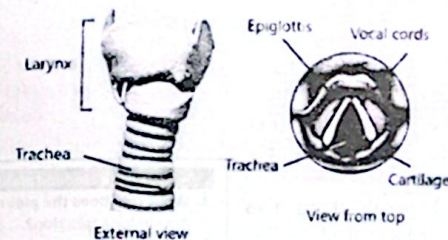


Figure: Larynx and Trachea

Check Understanding!

2. What are the advantages of breathing through the nose instead of the mouth?

- If swallowed material does start to **enter the larynx**, it irritates the larynx and stimulates a strong cough reflex.
- This generally expels the material out of the larynx, and into the **throat**.

(2) Lower Respiratory Tract (LRT):

- The **trachea** and other passages of the lower respiratory tract conduct air between the upper respiratory tract and the **lungs**. These passages make a **tree-like** shape, with repeated branching.
- There are an astonishing **2,414 kilometres** of airways conducting air through the human respiratory tract! It is only in the **lungs**, however, that gas exchange occurs between the **air and blood**.

Parts of Lower Respiratory Tracts:

(i) Trachea:

- The **trachea**, or windpipe, connects the **larynx** to the lungs for the passage of air.
- **Size:** It is the widest passageway in the respiratory tract. It is about **1 inch** wide and **4-6 inches** long.
- **Composition:** Its walls are made of **smooth muscles** and **C-shaped** rings of cartilage.
- **Functions:** The trachea is lined with **mucus** and **cilia**. The cilia propel foreign particles trapped in the mucus toward the **pharynx**.
- The **C-shaped cartilage** provides strength and support to the trachea to keep the passage open. The trachea branches at the bottom to form two **bronchi**.

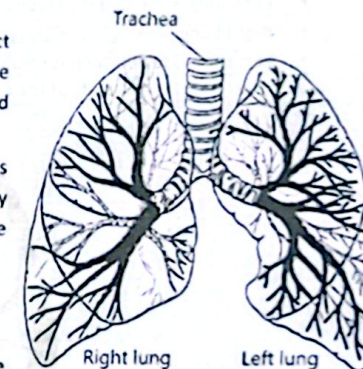


Figure: Tree-like branching of the lower respiratory tract

(ii) Bronchi:

- There are two **primary bronchi** (singular, bronchus).
- The **right and left bronchi** enter the **lungs** and branch into smaller, secondary bronchi.
- There are two secondary bronchi in left lung while three in right lung.

(iii) Tertiary Bronchi and Bronchioles:

- In **secondary bronchi**, the C-shaped cartilages are replaced with **cartilage plates**.
- The secondary bronchi branch into still smaller **tertiary bronchi**, which branch further into very small bronchioles.
- The bronchioles do not have **cartilage plates**.
- They divide many times and make terminal **bronchioles**.

(iv) Alveoli:

- The **terminal bronchioles** end in alveolar ducts which terminate in clusters of tiny air sacs, called **alveoli** (singular, alveolus), in the lungs.

(v) Lungs:

- The lungs are the **largest organs** of the respiratory tract.
- The outside of each lung is covered by **two membranes**.
- First Membrane Right Lungs:** Visceral pleura, lines the lungs.
- Second Membrane Called:** Parietal pleura, which lines the inner wall of **thoracic cavity**.
- Pleural Cavity:** The small space between these two membranes, called **pleural cavity**, is filled with fluid.
- This fluid allows the lungs to expand and contract freely during breathing.
- Each lung is divided into lobes.
- Right Lung:** The right lung is larger and contains three lobes.
- Left Lung:** The left lung is smaller and contains two lobes. The smaller left lung allows room for the heart, which is just left of the centre of the chest.

Check Understanding!

3. What role does the pleural cavity play in lung function?

- It dries the lungs
- It allows frictionless movement of lungs during breathing
- It strengthens alveolar walls
- It regulates blood flow

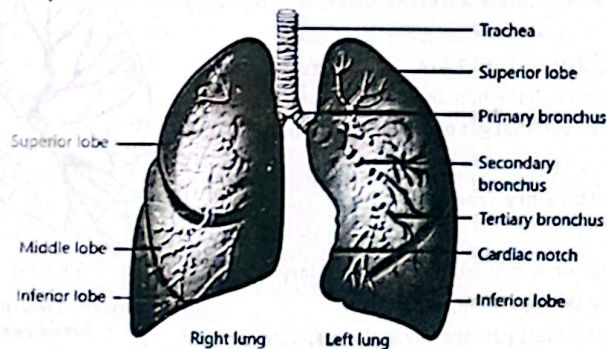


Figure: Right and left lungs

- As mentioned previously, the terminal bronchi end in alveolar ducts.
- Each alveolar duct opens in a cluster of alveoli. These clusters make the bulk of the lung and are surrounded by blood capillaries. Each cluster contains 20-30 alveoli.
- An alveolus is made of **moist epithelial tissue (only 0.1 micrometre thick)**. So, they provide the respiratory surface where gas exchange takes place between the air and blood.

- Some epithelial cells of alveoli secrete a liquid called **surfactant**, which lines the inside of alveoli.
- It prevents the alveoli from collapsing and sticking together.
- When air moves out of them.
- In healthy lungs, surfactant is constantly secreted and reabsorbed.

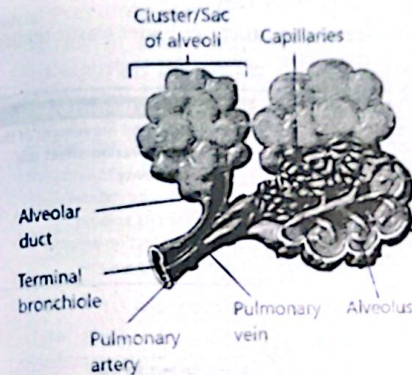


Figure: Clusters of alveoli

- The alveoli are the functional units of the lungs where gas exchange takes place. The two lungs may contain as many as **700 million alveoli**.
- They provide a **huge total surface area** for gas exchange. When we breathe in, the alveoli fill with air, making the lungs expand.
- Oxygen in the air inside the alveoli is absorbed by the blood via diffusion in the network of tiny capillaries that surround them.
- The blood in these capillaries also releases carbon dioxide (also by diffusion) into the air inside the alveoli. When we **breathe out**, air leaves the alveoli and rushes into the outside atmosphere, carrying carbon dioxide with it.

Recalling

- You have studied that **pulmonary arteries** carry deoxygenated blood to the lungs. This blood absorbs oxygen in the lungs and **pulmonary veins** carry the oxygenated blood back to the heart to be pumped throughout the body.
- The lungs also receive oxygenated blood from the heart that provides oxygen to the cells of the lungs for cellular respiration.

Check Understanding!

4. What is the role of the diaphragm in breathing?

- Atmospheric pressure** is lower at high altitudes.
- It means a greater increase in thorax is required to make the pressure in lungs lower than the atmospheric pressure. That is why it is harder to breathe at high altitudes. The body adapts mechanisms to improve oxygen uptake under these conditions, which is why athletes often undertake high altitude training prior to competitions.

Describe the mechanism of inhalation and exhalation.

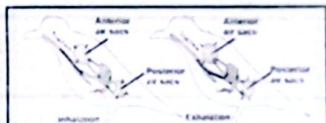
Exercise L.Q.1

Mechanism of Breathing or Ventilation:

- Breathing:** The movement of the air in and out of the body is called breathing or ventilation.
- Our lungs do not draw in air or push it out. Rather, it is done by creating negative and positive pressures in the lungs.
- This role is played by two sets of muscles i.e.,
 - Diaphragm:** Dome-like large skeletal muscle that separates thoracic cavity and abdomen and
 - Intercostal Muscles:** Present between each pair of ribs.
- Inspiration:** Taking in of air is called inspiration or inhalation.

Contraction of Diaphragm and Inter costal Muscle:

- For inspiration purpose, the diaphragm **contracts**.
- The contraction of diaphragm muscles cause the diaphragm to lower and take a more flattened shape.
- At the same time, the intercostal muscles also **contract**. It raises the ribs and **expands** the rib cage.
- These **contractions** increasing the space in the thorax. As a result, lungs **expand** because of the adherence of the visceral and parietal pleural membranes.
- The expansion of lungs lowers the air pressure inside lungs. As the result the pressure in lungs becomes lower than the atmospheric pressure and the air enters the lungs.



Lungs + Air Sacs in Birds

- Birds have lungs as well as air sacs in their body. Air flows in one direction. It flows from outside to posterior air sacs.
- For here, the air goes to the lungs, then to anterior air sacs, and then outside.
- The flow of air is in the **opposite direction** from blood flow. So, gas exchange takes place much more efficiently. This type of breathing enables birds to obtain the required oxygen, even at high altitudes where oxygen **concentration is low**.

- **Expiration:** Moving the air out of lungs is called expiration or exhalation.
- Expansion of the thorax and lungs during inspiration places these structures under elastic tension.

➤ Relaxation of Diaphragm and Inter Costal Muscles:

- This elastic tension is relieved by the relaxation of the intercostal muscles and diaphragm.
- When diaphragm relaxes, it assumes its dome-like shape.
- Similarly, when intercostal muscles relax, the ribs lower and rib cage moves inward.
- These movements decrease the space in thorax and allow the lungs to recoil. So, the pressure inside lungs becomes more than the atmospheric pressure and the air moves out of the lungs.

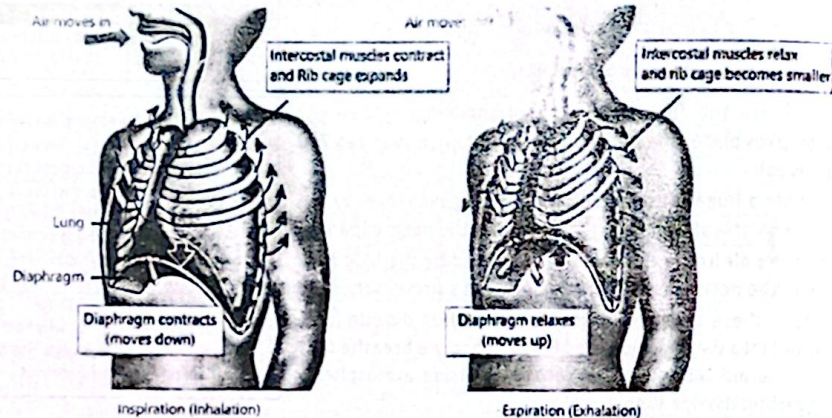


Figure: Mechanism of breathing

➤ Control of Breathing:

- Each breath is initiated by neurons in a respiratory centre located in the **medulla oblongata** i.e., a part of the brain stem.
- These neurons send impulses to the diaphragm and intercostal muscles, stimulating them to contract, causing inspiration. When these neurons stop producing impulses, the diaphragm and intercostal muscles relax and expiration occurs.

TRANSPORT OF GASES

- The process known as **gas transport** is an essential component of respiration.
- Oxygen is transported from lungs to all tissues and, at the same time, carbon dioxide is transported from tissue to the lungs.
- The following is a brief description of the mechanisms by which gases are transported in human body.

Q. Describe the transport of oxygen through blood.

[Exercise LQ4]

(1) Transport of Oxygen:

- The partial pressure of oxygen in alveoli allows to diffuse through alveoli into pulmonary capillaries. Inside the blood, small amount of oxygen dissolves in the blood plasma.
- Blood plasma can dissolve a maximum of only about **3mlO₂** per litre. Yet whole blood carries almost **200mlO₂** per litre! The reason is that most of the oxygen is not dissolved in blood plasma but is bound to molecules of haemoglobin inside the RBCs.

Partial Pressure of O₂ in Alveoli:

- The partial pressure of oxygen in alveoli (at sea level) is approximately **105 mm Hg**, which is less than the partial pressure of oxygen in the atmosphere. So, about **97%** of the haemoglobin within RBCs combines with oxygen and becomes **oxyhaemoglobin**.
- This molecule has a bright red, tomato juice colour. As the blood travels through the **blood capillaries**, some of the oxyhaemoglobin releases oxygen and becomes a **dark red** coloured **deoxyhaemoglobin**.
- **Pressure of O₂ in Tissues:** When blood leaves the tissue in the veins, it has a low partial pressure of oxygen (**40 mm Hg**).
- Here, **75%** of haemoglobin is saturated in the form of **oxyhaemoglobin**.
- It means that **22%** ($97\% - 75\% = 22\%$) of the oxyhaemoglobin has released its oxygen to the tissues, leaving **75%** oxyhaemoglobin in the blood as a reserve. This large reserve of oxygen enables the blood to fulfil the body's oxygen needs during exercise as well as at rest.

- **Oxyhaemoglobin:** It is bright red while deoxyhaemoglobin is dark red.
- **Haemoglobin:** But deoxyhaemoglobin imparts a **bluish** tinge to tissues.
- Because of these colour changes, vessels that carry oxygenated blood are always shown with a red colour, and vessels that carry oxygen-depleted blood are indicated with a blue colour.

Check Understanding!

6. How does the partial pressure of oxygen in alveoli facilitate oxygen diffusion into the blood?

Factors Affecting Oxygen Transport:

i. During Exercise:

- The muscles use more oxygen from the **capillary blood**.
- It decreases the venous blood partial pressure of oxygen to **20 mm Hg**.
- In this case, the percent saturation of haemoglobin drops from **75% to 35%**.
- Because arterial blood still contains **97%** oxyhaemoglobin, the amount of oxygen unloaded is now **(62%)** ($7\% \text{ minus } 35\% = 62\%$), instead of the **22%** at rest.

- The oxygen reserve also ensures that the blood contains enough oxygen to maintain life for four to five minutes if breathing is interrupted or if the heart stops pumping.

ii. PH:

- The **CO₂** produced by tissues lowers the pH of blood.
- This lowered pH reduces haemoglobin's affinity for oxygen and thus causes it to release oxygen more readily.

iii. Bohr's Effect:

- The effect of pH on haemoglobin's affinity for oxygen is known as the **Bohr Effect**.
- Increasing temperature has a similar effect on haemoglobin's affinity for oxygen. During exercise, skeletal muscles produce more heat, haemoglobin unloads a higher percentage of the oxygen.

Q. Describe the transport of carbon dioxide through blood.

[Exercise LQ4]

(2) Transport of Carbon dioxide:

- Blood capillaries deliver oxygen to the tissues and remove **carbon dioxide** from tissues.
- The partial pressure of **CO₂** is higher in tissues than in blood. It causes the **carbon dioxide** to enter from tissues into blood. While, the process reverses in **lungs** where the partial pressure of **CO₂** is lower in alveoli than in blood.
- Blood transports carbon dioxide from tissues to lungs in three ways.

(i) As Bicarbonate Ions [72%]:

- Approximately **72%** of carbon dioxide is carried in the blood as **bicarbonate ions**.
- **Formation of H₂CO₃:** CO₂ enters the RBCs and combines with water to form carbonic acid (H₂CO₃) in the presence of enzyme **carbonic anhydrase**.
- Carbonic acid (H₂CO₃) dissociates to form hydrogen ions (H⁺) and bicarbonate ions (HCO₃⁻).

- The formation of **carbonic acid** is important in maintaining the acid base balance of the blood, because bicarbonate serves as the major buffer of the blood plasma.

Dissociation of H⁺ and HCO₃⁻ ions:

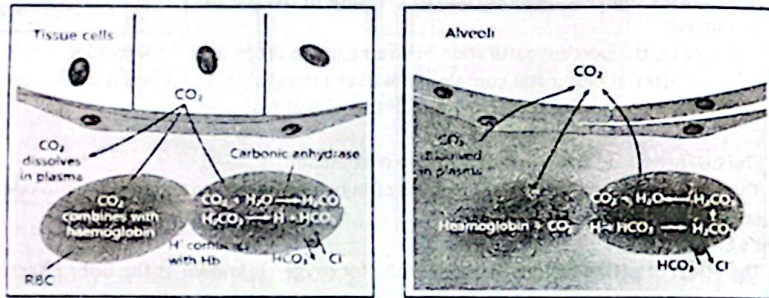
- The **hydrogen ion** readily associates with oxyhaemoglobin and oxygen of oxyhaemoglobin is released to the tissue.
- While the bicarbonate ions (HCO₃⁻) moves out from RBCs into plasma.
- The movement of bicarbonate ions (HCO₃⁻) is facilitated by a transporter that exchanges one **chloride ion (Cl⁻)** for a bicarbonate ion (this is called the "chloride shift" or "Hamburger phenomenon").

(ii) As Carboxyhaemoglobin [20%]:

- About 20% of CO₂ is carried as carboxyhaemoglobin.
- When partial pressure of CO₂ is higher in blood than tissues, CO₂ combines with the globin chains of haemoglobin and forms carboxyhaemoglobin.

(iii) As dissolved CO₂ in Plasma [08%]:

- When CO₂ enters blood, a little amount dissolves in the water of blood plasma. About 8% of CO₂ is carried this way.
- The blood carries CO₂ in these three forms to the lungs. The **lower PCO₂** of the air inside the alveoli causes the conversion of H₂CO₃ into H₂O and CO₂.
- The CO₂ diffuses out of blood into the alveoli, so that it can leave the body in the next exhalation.

**Figure: Transport of Carbon dioxide by blood****Carbon Monoxide Poisoning**

- Incomplete combustion of fuels such as wood, gasoline, propane, or natural gas produces CO gas.
- If gas heaters are left burning overnight in closed environments, CO accumulates in the room.
- It enters the body through inhalation and binds to haemoglobin with a much higher affinity than oxygen. This binding reduces the amount of haemoglobin available to transport oxygen to the body's tissues, leading to tissue hypoxia (oxygen deprivation). It leads to CO poisoning.
- Symptoms of CO Poisoning:** Include headache, dizziness, weakness, nausea, confusion, shortness of breath, chest pain, and loss of consciousness.
- Severe Poisoning:** In severe cases, it can cause permanent brain damage, and even death.

RESPIRATORY PIGMENTS

- Respiratory pigments are special proteins in blood or tissues and are involved in transporting oxygen throughout body.
- They also serve other purposes e.g., O₂ storage, CO₂ transport, and transport of substances other than respiratory gases.
- The two well-known respiratory pigments are haemoglobin and myoglobin.

Q. Describe the structure and function of haemoglobin.**[Exercise L.O.4]****(1) Haemoglobin:**

- Location:** Haemoglobin is a protein present in RBCs.

Structure of Haemoglobin:

- A haemoglobin molecule is composed of **four globin (globular) polypeptide chains** (two α chains and two β) and four haem groups.
- There are **141 and 146** amino acids in the α and β chains, respectively.
- Each polypeptide chain is folded in such a way that it contains a **pocket** where the heme group binds. So, each chain is associated with a haem group.
- A **haem group** consists of an iron ion held in a porphyrin ring. The iron ion is attached with four nitrogen atoms of the polypeptide chain.
- Importance:**
 - Under higher partial pressure of oxygen, iron ion attaches a **molecule of O₂**.
 - In this way, one haemoglobin molecule can carry up to **four O₂ molecules**.

The four polypeptide chains of haemoglobin are bound to each other by salt bridges, hydrogen bonds, and hydrophobic effect.

Check Understanding!
8. Why doesn't myoglobin exhibit cooperative binding?

(2) Myoglobin:

- Location:** Myoglobin is the **oxygen-binding** protein in skeletal and cardiac muscle cells of vertebrates.
- It gives a distinct **red or dark gray colour** to muscles.
- Structure of Myoglobin:**
 - It is a **monomer**, composing of a single polynucleotide chain (**made of 153 amino acids**) and contains a **single haem group**. Therefore, it is capable of binding with a single O₂ molecule.
- Importance of Myoglobin:**
 - The binding affinity of myoglobin is high as compared to that of haemoglobin. As a result, myoglobin serves as the **oxygen-storing** protein in muscles. It releases oxygen when the partial pressure of oxygen is below 20 mm Hg.
 - In this way, myoglobin provides oxygen to the muscles when they need.

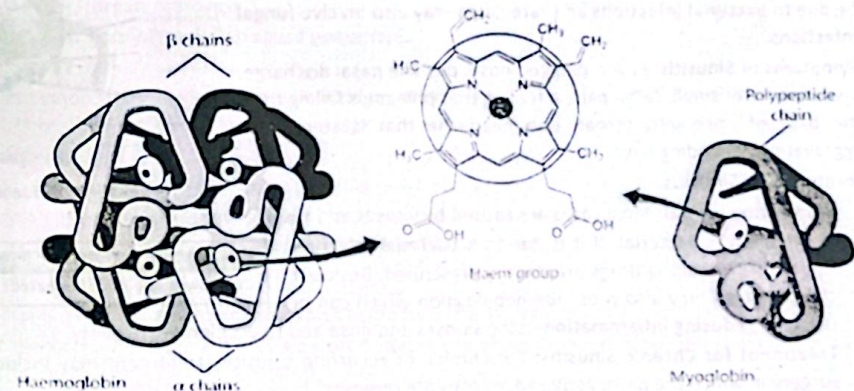
**Figure: Structure of haemoglobin and myoglobin**

Table: Differences between Haemoglobin and Myoglobin

	Haemoglobin	Myoglobin
1.	• Consists of four polypeptide chains.	• Consists of one polypeptide chain.
2.	• Possesses four haem groups.	• Possesses one haem group
3.	• Found in blood (RBCs).	• Found in skeletal and cardiac muscles.
4.	• Can attach four O ₂ molecules	• Can attach one O ₂ molecule.
5.	• Transports oxygen.	• Stores oxygen.
6.	• Has less affinity with oxygen.	• Has more affinity with oxygen.
7.	• Loses oxygen at PO ₂ :60 mmHg	• Loses oxygen at PO ₂ :20 mmHg.

RESPIRATORY DISORDERS

- Many disorders can affect the respiratory system and interfere with respiration.
- These respiratory disorders can range from mild and self-limiting conditions such as the common cold to more severe diseases such as sinusitis, otitis media, pneumonia, pulmonary tuberculosis, emphysema and chronic obstruction pulmonary disease COPD.

(a) Upper Respiratory Tract Infections: (URTI)

- Upper Respiratory-tract infections (URIs) affect:
 - (a) Nose
 - (b) Throat
 - (c) Sinuses
 - (d) Larynx
- These infections can be easily transmitted from person to person through respiratory droplets.

Check Understanding!

9. What is a typical sign of acute otitis media in a non-verbal infant?

- A. Sneezing
- B. Tugging at the ear and irritability
- C. Constant blinking
- D. Diarrhea

Q. Describe the causes, symptoms and treatment of sinusitis.

(1) Sinusitis:

- It is the inflammation of the lining of the sinuses.
- **Sinuses:** These are four paired air-filled spaces that surround the nasal cavity.
 - (i) Under the Eyes
 - (ii) Above the Eyes
 - (iii) Between the Eyes
 - (iv) Behind the Eyes
- It may be acute (lasts for 7 to 10 days) or chronic (lasts longer than 12 weeks)
- **Causes:** Most cases of sinusitis are due to viral infections; some may be due to bacterial infections and rare cases may also involve fungal infections.
- **Symptoms of Sinusitis:** Fever, plugged nose, pus-like nasal discharge, loss of sense of smell, facial pain, a feeling that phlegm is falling from the back of nose into throat, and headache that is sometimes aggravated by bending over.



Figure: Sinuses

- **Treatment of Sinusitis:**
 - If infection is Viral: Most cases are caused by viruses and resolve without antibiotics.
 - If infection is Bacterial: If it is due to a bacterial infection, antibiotics or sulpha drugs are usually prescribed. Beside it, the physician may also prescribe nebulization which can be useful in reducing inflammation in the sinuses and nose and to accelerate recovery.
 - **Treatment for Chronic Sinusitis:** For chronic or recurring sinusitis, treatment may include nasal surgery in which the pathogens and mucous are removed

Check Understanding!

10. How is pneumonia treated?

(2) Otitis Media:

- It is the inflammation of the middle ear.
- **Otitis may be:**
 - (a) **Acute Otitis Media:** Which is rapid onset
 - (b) **Chronic Otitis Media:** Which lasts more than six weeks.
- **Common Cause:** The common cause of otitis media accumulation of fluid in Eustachian tube, which cannot be drained from the middle ear. When this fluid is not drained, it allows the growth of bacteria and viruses in the middle ear that lead to otitis media.
- **Symptoms of Otitis Media:** Severe ear pain, pulling at one or both ears, fever, fluid draining from ear(s), loss of balance, and hearing difficulties.
- **Treatments** include oral and topical pain killers and antibiotics (if caused by bacterial infection).

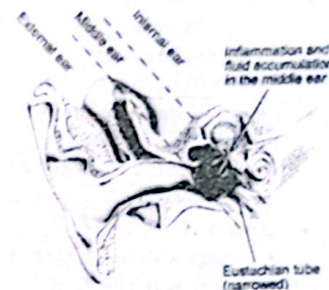


Figure: Otitis media

- Pneumonia killed more than 808 000 children under the age of 5 in 2017, accounting for 15% of all deaths of children under 5 years.

(b) Lower Respiratory Tract Infections: (LRTI)

- Lower Respiratory-tract Infections include:
 - (1) Pneumonia
 - (2) Pulmonary tuberculosis
 - (3) Lung abscess
 - (4) Bronchitis

Q. Describe the causes, symptoms and treatment of pneumonia and pulmonary tuberculosis.

(1) Pneumonia:

- Pneumonia is a form of acute respiratory infection. It can cause mild to life-threatening illness.
- **Effects on body:** In pneumonia, the alveoli of one or both lungs are inflamed and are filled with pus and fluid. It makes breathing painful and limits oxygen intake.
- **Causes:** Pneumonia is most commonly caused by viruses or bacteria.
- It is the single largest infectious cause of death in children worldwide.
- A variety of organisms:
 - (a) **Primarily Bacteria:** Particularly *Streptococcus pneumoniae*
 - (b) **Viruses:** Human rhinovirus.
 - (c) **Less Commonly Fungi:** Can cause pneumonia.
- **Symptoms:**
 - Its symptoms include cough with phlegm, shortness of breath, chest pain, fever, blueness of skin, loss of appetite, high heat rate, and fatigue.
- **Treatment:**
 - Specific antibiotics are used to treat bacterial pneumonia.
 - Analgesics pain killers also used to reduce fever and pain. Vaccination prevents against certain bacterial and viral pneumonias both in children and adults.

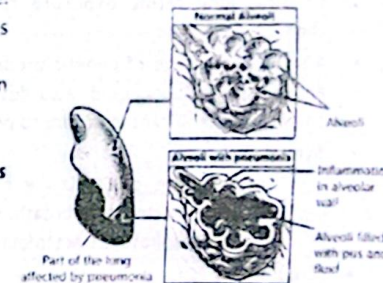


Figure: Pneumonia

(2) Pulmonary Tuberculosis:

- Tuberculosis (TB) is a chronic infection caused by bacteria.
- **Mycobacterium Tuberculosis Effects on Body:** It can affect many parts of the body but it generally affects the lungs.
- The tuberculosis of the lungs is called pulmonary tuberculosis.
- It is highly contagious and spreads through cough or sneezes.

- The bacteria enter the lungs, multiply and cause inflammation and damage to the lung tissue, including the alveoli. The damage to the alveoli can lead to the formation of small cavities or holes in the lung tissue, which can make it difficult for the lungs to function properly.
- Advanced Stages:** In advanced stages, the alveoli are so damaged that the lungs may become unable to supply the body with enough oxygen. This can lead to a condition called respiratory failure, which is a medical emergency.

Symptoms:

- Cough with Blood:** Major symptoms of pulmonary tuberculosis are cough-with blood.
- Intermittent fever usually in the evening, night sweats, weight loss, anorexia, depression, weakness and dry cough, chest pain due to inflammation of the pleura of the lungs.

Treatment:

- Includes the use of multiple antibiotics over a long period of time (for 9 months) regularly.

Disorders of the Lungs:

Chronic obstructive pulmonary disease (COPD) is an important disorder of the lungs.

(1) Chronic Obstructive Pulmonary Disease (COPD):

- Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory disease of lungs.
- Common Causes:** The common causes of COPD are tobacco smoking, long terms exposure to harmful pollutants and chemical fumes etc.
- A small percentage of genetic predisposition (protein alpha-1 antitrypsin deficiency) can also develop COPD, even without smoking or significant exposure to pollutants.
- Symptoms:**
 - The symptoms of COPD are persistent cough with mucus (sputum), shortness of breath, wheezing, chest, fatigue and frequent respiratory tract infections.
- Treatment:**
 - COPD is incurable but by minimizing exposure to smoke, pollutants, and chemicals, this disease can slow its progression.
 - Others therapies include bronchodilators, Inhaled corticosteroids, pulmonary rehabilitation, and oxygen therapy.
 - In some severe cases, surgery such as lung transplantation may be considered

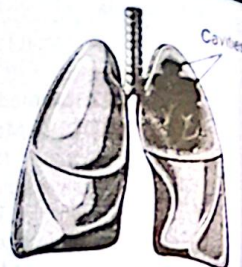


Figure: A lung affected with TB

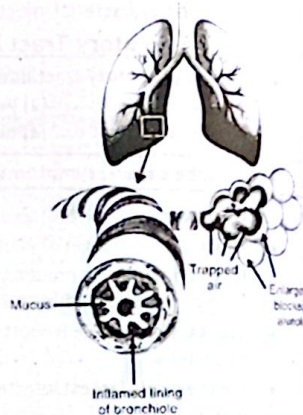


Figure: A lung affected by COPD

Check Understanding!

11. Why is oxygen therapy sometimes required for COPD patients?
- To speed up heart rate
 - To thicken lung tissue
 - To improve oxygen supply to tissues
 - To prevent mucus formation

- Chronic bronchitis is a type of COPD.
- It involves inflammation and narrowing of the bronchial tubes in the lungs. It leads to increased mucus production, which can further block the airways and make breathing difficult. This disease lasts for three months to two years.
- It is caused by long-term exposure to irritants such as cigarette smoke, air pollution, or industrial dusts. Symptoms of chronic bronchitis are almost same as of COPD such as wheezing, shortness of breath, chest tightness, and frequent respiratory infections.
- Chronic bronchitis can be managed by quitting smoking. Other treatments are bronchodilators, pulmonary rehabilitation, and in some cases oxygen therapy.

Q. Describe causes, symptoms and treatment of emphysema.

[Exercise L.O.7]

(2) Emphysema:

- Emphysema is a type of COPD.
- Effects:** In emphysema, the inner walls of alveoli are damaged, causing them to eventually rupture. This creates one larger air space instead of many small ones and reduces the surface area available for gas exchange.
- Causes:** The primary cause of emphysema is smoking. It can also be caused by long-term exposure to air pollution, dust, or chemical fumes.
- Emphysema disease can also be caused by a genetic deficiency of a protein called alpha-1 anti-trypsin.
- Symptoms:**
 - The symptoms of emphysema include shortness of breath, coughing, wheezing, fatigue, and chest tightness.
- Treatment:**
 - Quitting smoking is the most important step in managing emphysema, as continued smoking can speed up the progression of disease.
 - Other treatments include bronchodilators, inhaled steroids, oxygen therapy, and pulmonary rehabilitation.

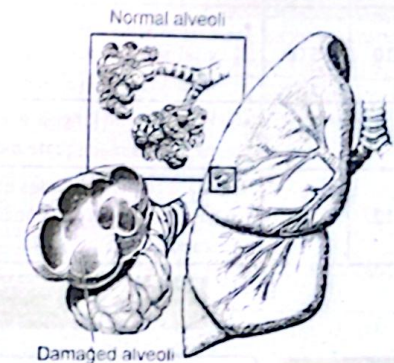


Figure: Emphysema

Check Understanding!

12. How is COPD managed or treated?

Check Understanding (Solutions)

Sr. #	Option	Explanation
1.	B	A thin respiratory surface shortens the diffusion path for gases like oxygen and carbon dioxide, allowing them to pass quickly and efficiently across the membrane.
2.	S.Q	Nasal breathing filters out particles, warms, and moistens the air, protecting delicate lung tissues. It also helps regulate airflow and enhances the sense of smell, which mouth breathing cannot provide.
3.	B	The pleural cavity contains fluid that lubricates lung surfaces, reducing friction during breathing movements and allowing lungs to expand smoothly.
4.	S.Q	The diaphragm is a dome-shaped muscle that contracts and flattens during inspiration, increasing thoracic cavity volume and decreasing pressure to draw air into the lungs. During expiration, it relaxes and returns to its dome shape, aiding in expelling air.
5.	B	During inspiration, the ribs move upward and outward, expanding the thoracic cavity and increasing its volume, which aids in drawing air into the lungs.
6.	S.Q	<ul style="list-style-type: none"> High Alveolar pO₂: The alveolar pO₂ is approximately 104 mmHg, creating a gradient that drives oxygen diffusion into the pulmonary capillaries. Efficient Gas Exchange: This gradient ensures efficient oxygen uptake by hemoglobin in red blood cells.
7.	A	Approximately 5-7% of carbon dioxide is transported in the blood dissolved directly in plasma, owing to its higher solubility compared to oxygen.
8.	S.Q	Structural Reason: As a monomer with a single oxygen-binding site, myoglobin lacks the multiple subunits necessary for cooperative interactions.

9.	B	• Non-verbal infants often tug or pull at the infected ear, display irritability, and may have fever or trouble sleeping, indicating middle ear infection.
10.	S.Q	• Treatment depends on the cause. Bacterial pneumonia is treated with antibiotics, while viral pneumonia may require rest, fluids, and antiviral drugs. Hospitalization may be needed in severe cases.
11.	C	• In COPD, the lungs are less efficient at oxygen exchange, so supplemental oxygen is used to maintain adequate blood oxygen levels.
12.	S.Q	• Management includes quitting smoking, using bronchodilators, steroids, oxygen therapy, and pulmonary rehabilitation. Though not curable, symptoms can be controlled to improve quality of life.

Exercise

Exercise

MULTIPLE CHOICE QUESTIONS (MCQs)

Section 01

- During Inhalation, diaphragm:**
 - Contracts and moves upward
 - Contracts and moves downward
 - Relaxes and moves upward
 - Relaxes and moves downward
- Which part of the respiratory system acts as the respiratory surface?**
 - Larynx
 - Trachea
 - Bronchi
 - Alveoli
- How many oxygen molecules can attach with a haemoglobin molecule?**
 - 1
 - 2
 - 3
 - 4
- What is TRUE about respiratory pigments?**
 - Transport oxygen from lungs to tissues
 - Transport oxygen and carbon dioxide in equal amounts
 - Transport less oxygen and more carbon dioxide
 - Regulate the pH of blood
- Which respiratory pigment is found in muscle tissue?**
 - Haemoglobin
 - Melanin
 - Myoglobin
 - Chlorophyll
- What is the maximum amount of air that can be inhaled or exhaled during a respiratory cycle?**
 - Tidal volume
 - Vital capacity
 - Inspiratory reserve volume
 - Expiratory reserve volume
- In what form is carbon dioxide primarily transported in the bloodstream?**
 - Dissolved in plasma
 - Bound to haemoglobin
 - Converted to bicarbonate ions
 - None of the above
- Which of the following treatments is commonly used to manage pulmonary TB?**
 - Antibiotics
 - Cough syrup
 - Surgery
 - Chemotherapy
- Which of the following is a common cause of pneumonia?**
 - Bacterial infection
 - Viral infection
 - Fungal infection
 - All of these
- Emphysema is characterized by:**
 - Inflammation of airways
 - Narrowing of airways
 - Destruction of the alveoli in lungs
 - Fluid build-up in lungs

Answer Key with Explanations

Sr.No.	Option	Answer	Explanations
1.	(b)	Contracts and moves downward	• During inhalation, the diaphragm contracts and flattens, moving downward to increase thoracic volume and allow air in.
2.	(d)	Alveoli	• Alveoli are the primary respiratory surfaces where gas exchange occurs due to their thin walls and rich blood supply.
3.	(d)	4	• Each hemoglobin molecule can bind to 4 oxygen molecules — one per iron atom in the four heme groups.
4.	(a)	Transport oxygen from lungs to tissues	• Respiratory pigments like hemoglobin carry oxygen from the lungs to the body tissues.
5.	(c)	Myoglobin	• Myoglobin is the oxygen-binding pigment found specifically in muscle tissues.
6.	(b)	Vital capacity	• Vital capacity is the maximum amount of air a person can exhale after a maximum inhalation.
7.	(c)	Converted to bicarbonate ions	• Most carbon dioxide in blood is transported as bicarbonate ions after reacting with water in red blood cells.
8.	(a)	Antibiotics	• Pulmonary TB is caused by bacteria (<i>Mycobacterium tuberculosis</i>), so antibiotics are the standard treatment.
9.	(a)	Bacterial infection	• Pneumonia is commonly caused by bacteria such as <i>Streptococcus pneumoniae</i> .
10.	(c)	Destruction of the alveoli in lungs Destruction of the alveoli in lungs	• Emphysema involves the breakdown of alveolar walls, reducing the surface area for gas exchange.

Exercise

SHORT ANSWER QUESTIONS

Section 02

Q.1 Define respiratory surface and list its properties.

Ans. A respiratory surface is a specialized area where gas exchange (oxygen and carbon dioxide) occurs between an organism and its environment.

Properties:

- **Moist:** Facilitates diffusion of gases.
- **Thin:** Minimizes diffusion distance (e.g., one-cell thick in alveoli).
- **Large Surface Area:** Enhances gas exchange efficiency.
- **Ventilated:** Ensures continuous supply of fresh air.

Q.2 How nasal cavity functions in filtering the inhaled air?

Ans. Function of Nasal Cavity:

- **Hairs (Vibrissae):** Trap large particles like dust.
- **Mucus:** Captures smaller particles and pathogens.
- **Ciliated Epithelium:** Sweeps mucus and trapped debris toward the throat.
- **Warms and Humidifies Air:** Blood vessels in nasal mucosa adjust air temperature and moisture.

Q.3 Trace the path of air through different parts of the respiratory system.

Ans. Path of air through Different Parts of the Respiratory System:

- **Nasal Cavity/Oral Cavity:** Air enters.
- **Pharynx:** Shared pathway for air and food.

- **Larynx:** Contains vocal cords; directs air to trachea.
- **Trachea:** Windpipe reinforced with cartilage rings.
- **Bronchi:** Branch into left and right lungs.
- **Bronchioles:** Smaller branches within lungs.
- **Alveoli:** Site of gas exchange.

Q.4 Describe the structure and function of alveoli.

Ans. Structure and Function of Alveoli:

- Tiny, grape-like sacs surrounded by capillaries.
- Thin walls (one-cell thick) composed of squamous epithelium.

Function:

- Oxygen diffuses into blood from alveoli.
- Carbon dioxide diffuses out of blood into alveoli for exhalation.

Q.5 What is the role of diaphragm during inhalation and exhalation?

Ans. Role of Diaphragm During Inhalation and Exhalation:

- **Inhalation:** Diaphragm contracts, flattens, and moves downward, expanding the thoracic cavity. Creates negative pressure, pulling air into lungs.
- **Exhalation:** Diaphragm relaxes, domes upward, reducing thoracic cavity volume. Increases pressure, forcing air out.

Q.6 What are the three ways of the transport of carbon dioxide in blood?

Ans. (i) As Bicarbonate Ions [72%]:

- Approximately 72% of carbon dioxide is carried in the blood as bicarbonate ions.
- **Formation of H_2CO_3 :** CO_2 enters the RBCs and combines with water to form carbonic acid (H_2CO_3) in the presence of enzyme carbonic anhydrase.
- Carbonic acid (H_2CO_3) dissociates to form hydrogen ions (H^+) and bicarbonate ions (HCO_3^-).
- **Dissociation of H^+ and HCO_3^- Ions:** The hydrogen ion readily associates with oxyhaemoglobin and oxygen of oxyhaemoglobin is released to the tissue.
- While the bicarbonate ions (HCO_3^-) moves out from RBCs into plasma.

(ii) As Carboxyhaemoglobin [20%]:

- About 20% of CO_2 is carried as carboxyhaemoglobin.
- When partial pressure of CO_2 is higher in blood than tissues, CO_2 combines with the globin chains of haemoglobin and forms carboxyhaemoglobin.

(iii) As dissolved CO_2 in Plasma [08%]:

- When CO_2 enters blood, a little amount dissolves in the water of blood plasma. About 8% of CO_2 is carried this way.

Q.7 What are the advantages of having millions of alveoli rather than a pair of simple balloon-like lungs?

Ans. Advantages of Having Millions of Alveoli:

- **Increased Surface Area:** Millions of alveoli provide $\sim 70 m^2$ surface area for efficient gas exchange.
- **Optimal Diffusion:** Thin walls and proximity to capillaries maximize diffusion rate.
- **Reduced Dead Space:** Alveoli prevent air stagnation, unlike large, hollow balloons.

Q.8 Differentiate between:

- | | |
|---------------------------------------|--|
| (i) Internal and external respiration | (ii) Upper and lower respiratory tract |
| (iii) Bronchi and bronchioles | (iv) Haemoglobin and myoglobin |

Ans. (i) Internal vs. External Respiration:

- **Internal:** Cellular process; oxygen used to produce ATP, CO_2 generated as waste.
- **External:** Exchange of gases between lungs and blood (alveoli and capillaries).

(ii) Upper vs. Lower Respiratory Tract:

- **Upper:** Nose, nasal cavity, pharynx (filters/warms air)
- **Lower:** Larynx, trachea, bronchi, lungs (conducts air to alveoli)

(iii) Bronchi vs. Bronchioles:

- **Bronchi:** Larger, cartilage-supported tubes entering lungs.
- **Bronchioles:** Smaller, smooth muscle-lined branches ending in alveoli.

(iv) Hemoglobin vs. Myoglobin:

- **Hemoglobin:** In red blood cells; transports O_2 from lungs to tissues.
- **Myoglobin:** In muscle cells; stores O_2 for use during muscle contraction.

Exercise

LONG ANSWER QUESTIONS

Section 03

Q.1 Describe the mechanism of inhalation and exhalation.

Ans. See Page No. (291)

Q.2 Describe the transport of oxygen through blood.

Ans. See Page No. (292)

Q.3 Describe the transport of carbon dioxide through blood.

Ans. See Page No. (293)

Q.4 Describe the structure and function of haemoglobin.

Ans. See Page No. (295)

Q.5 Describe the causes, symptoms and treatment of sinusitis.

Ans. See Page No. (296)

Q.6 Describe the causes, symptoms and treatment of pneumonia and pulmonary tuberculosis.

Ans. See Page No. (297)

Q.7 Describe causes, symptoms and treatment of emphysema.

Ans. See Page No. (299)

Exercise

INQUISITIVE ANSWER QUESTIONS

Q.1 How does the structure of the alveoli optimize the exchange of gases like oxygen and carbon dioxide?

- Ans.
- **Thin Walls:** Alveoli have one-cell-thick walls, allowing fast and easy diffusion of oxygen and carbon dioxide.
 - **Large Surface Area:** Millions of alveoli create a huge surface area, maximizing contact between air and blood.
 - **Rich Blood Supply:** Each alveolus is surrounded by capillaries, ensuring continuous transport of gases.
 - **Moist Lining:** The inner moist surface helps dissolve gases, which is essential for efficient diffusion.

Q.2 How do diseases like chronic obstructive pulmonary disease (COPD) affect gaseous exchange efficiency?

- Ans.
- **Damage to Alveoli:** COPD causes destruction of alveolar walls, reducing the surface area for gas exchange.
 - **Air Trapping:** Air gets trapped in damaged alveoli, preventing fresh oxygen from entering effectively.
 - **Reduced Elasticity:** Loss of lung elasticity makes it harder to exhale fully, disrupting proper ventilation.
 - **Poor Oxygen Supply:** As a result, less oxygen reaches the blood and carbon dioxide removal is impaired, reducing overall gas exchange efficiency.

Q.3 Can you explain the process of external respiration versus internal respiration in the context of gaseous exchange?

Ans. Differences Between External and Internal Respiration

Feature	External Respiration	Internal Respiration
• Location	• Occurs in the lungs (alveoli and capillaries)	• Occurs in body tissues (cells and capillaries)
• Oxygen Movement	• Oxygen moves from alveoli to blood	• Oxygen moves from blood to body cells
• Carbon Dioxide Movement	• CO ₂ moves from blood to alveoli	• CO ₂ moves from cells to blood
• Purpose	• To oxygenate the blood and remove CO ₂	• To supply oxygen to tissues and pick up CO ₂
• Gas Exchange Surface	• Across the respiratory membrane	• Across capillary-cell membrane interface

Q.4 How does the transport of oxygen in the bloodstream support cellular respiration?

- Ans.
- **Hemoglobin Binding:** Oxygen binds to hemoglobin in red blood cells, allowing efficient transport from lungs to tissues.
 - **Delivery to Cells:** At tissues, oxygen is released from hemoglobin and diffuses into cells where it's needed for respiration.
 - **Energy Production:** Inside cells, oxygen is used in mitochondria to break down glucose during aerobic respiration, producing ATP (energy).

Q.5 What are the environmental factors that can influence gaseous exchange in humans?

Ans. Environmental Factors Influence Gaseous Exchange in Humans:

- **Altitude:** At high altitudes, lower oxygen pressure reduces the amount of oxygen available for diffusion into blood.
- **Air Pollution:** Pollutants like smoke and dust can irritate or block airways, making gas exchange less efficient.
- **Temperature and Humidity:** Extreme temperatures and low humidity can dry out airways and reduce lung efficiency.
- **Oxygen Concentration:** Lower environmental oxygen levels (e.g., in confined or poorly ventilated spaces) impair gas exchange.

ADDITIONAL MCQs

- What is the primary function of the respiratory surface in the human body?
 - To filter the air we breathe and warm it to body temperature
 - To exchange oxygen and carbon dioxide between the lungs and bloodstream
 - To produce surfactant to reduce surface tension in the lungs
 - To regulate blood pH levels
- Which of the following structures is NOT directly involved in gas exchange?
 - Alveoli
 - Bronchioles
 - Trachea
 - Pleura
- What is the role of the diaphragm in the ventilation mechanism?
 - To relax and move upwards during both inhalation and exhalation
 - To contract and move downwards during inhalation and relax during exhalation
 - To contract and move upwards during exhalation and relax during inhalation
 - To remain stationary during both inhalation and exhalation

4. How is oxygen transported in the blood?

- Primarily dissolved in plasma, with a small amount bound to hemoglobin
 - Primarily bound to hemoglobin in red blood cells, with a small amount dissolved in plasma
 - Exclusively bound to hemoglobin in red blood cells
 - Exclusively dissolved in plasma
5. What is the primary cause of chronic bronchitis?
- Viral infections
 - Bacterial infections
 - Long-term exposure to pollutants such as cigarette smoke
 - Genetic predisposition
6. Which of the following is a characteristic symptom of asthma?
- Chronic coughing that worsens at night
 - Shortness of breath that improves with exercise
 - Chest pain that radiates to the arm
 - Wheezing that disappears after taking antibiotics
7. What is emphysema?
- A condition characterized by inflammation of the airways
 - A condition characterized by damage to the alveoli, leading to breathlessness
 - A condition characterized by excessive mucus production in the lungs
 - A condition characterized by a collapsed lung
8. Which of the following is a lower Respiratory Tract Infection?
- Sinusitis
 - Pharyngitis
 - Bronchiolitis
 - Laryngitis
9. What is the main structural feature of the lungs that allows for gas exchange?
- The presence of cartilage in the bronchi
 - The branching of the bronchioles
 - The thin walls of the alveoli
 - The presence of smooth muscle in the airways
10. Which of the following conditions is characterized by reversible airflow limitation?
- Chronic Obstructive Pulmonary Disease (COPD)
 - Asthma
 - Pneumonia
 - Emphysema
11. What is the primary function of surfactant in the lungs?
- To warm the air we breathe to body temperature
 - To humidify the air we breathe
 - To reduce surface tension in the alveoli
 - To filter out dust particles from the air we breathe
12. Which of the following is a consequence of Chronic Obstructive Pulmonary Disease (COPD)?
- Increased lung capacity
 - Improved lung function with age
 - Irreversible airflow limitation
 - Reduced risk of respiratory infections

ANSWER KEY

1. B) 2. D) 3. B) 4. B) 5. C) 6. A) 7. B) 8. C) 9. C) 10. B) 11. C) 12. C)

ADDITIONAL SHORT ANSWER QUESTIONS

Q.1 What is the respiratory surface, and what are its key properties?

Ans. The respiratory surface is the area where gas exchange occurs between the lungs and the bloodstream. Its key properties include being thin, moist, and having a large surface area. This allows for efficient exchange of oxygen and carbon dioxide. The respiratory surface is also richly supplied with blood vessels. The thinness of the respiratory surface enables gases to diffuse easily.

Q.2 How does the structure of the respiratory surface facilitate gas exchange?

Ans. The structure of the respiratory surface facilitates gas exchange by allowing oxygen to diffuse into the blood and carbon dioxide to diffuse out. The large surface area and thinness of the respiratory surface enable efficient gas exchange. The moist environment also helps to facilitate the diffusion of gases. This process is essential for the delivery of oxygen to the body's tissues.

Q.3 What are the main components of the human respiratory system, and what are their functions?**Ans. Main Components of the Human Respiratory System:**

- The main components include the **nose, mouth, pharynx, larynx, trachea, bronchi, and lungs**.
- Each part has distinct functions, such as the lungs being responsible for gas exchange.
- The nose and mouth are responsible for bringing air into the respiratory system.
- The **pharynx, larynx, trachea, and bronchi** form the airways that lead to the lungs.

Q.4 Describe the structural features of the lungs that enable gas exchange.**Ans. Structural Features of the Lungs:**

- The lungs have alveoli, which are small air sacs where gas exchange occurs.
- The alveoli are surrounded by a rich network of blood capillaries.
- The thin walls of the alveoli and capillaries enable the efficient exchange of oxygen and carbon dioxide. The lungs are also highly vascularized, which facilitates gas exchange.

Q.5 What is the ventilation mechanism in humans, and how does it work?**Ans. Ventilation Mechanism in Humans:**

- The ventilation mechanism involves the movement of air in and out of the lungs through the process of breathing.
- It is facilitated by the diaphragm and intercostal muscles.
- The diaphragm contracts and relaxes to change the volume of the chest cavity.
- This change in volume creates a pressure gradient that drives air into and out of the lungs.

Q.6 How do the diaphragm and intercostal muscles contribute to ventilation?**Ans. Diaphragm and Intercostal Muscles Contribute to Ventilation:**

- The diaphragm and intercostal muscles work together to facilitate breathing.
- The diaphragm contracts and relaxes to change the volume of the chest cavity.
- The intercostal muscles help to expand and contract the rib cage, further increasing the volume of the chest cavity. This coordinated movement enables efficient ventilation.

Q.7 How is oxygen transported from the lungs to the body's tissues?**Ans. Transport of O₂:**

- Oxygen is transported from the lungs to the body's tissues bound to hemoglobin in red blood cells.
- Hemoglobin has a high affinity for oxygen, allowing it to bind to oxygen in the blood.
- The oxygen is then released to the tissues, where it is used for cellular respiration.

Q.8 What is the role of hemoglobin in transporting oxygen and carbon dioxide?**Ans. Role of Hemoglobin in Transporting Oxygen and Carbon Dioxide:**

- Hemoglobin plays a crucial role in transporting oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs.
- Hemoglobin binds to oxygen in the lungs and releases it to the tissues.
- It also binds to carbon dioxide in the tissues and transports it back to the lungs.

Q.9 What are respiratory pigments, and what is their function in the body?**Ans. Respiratory Pigments and Function in the Body:**

- Respiratory pigments, such as hemoglobin, facilitate the transport of oxygen and carbon dioxide in the blood.
- They bind to these gases, allowing them to be transported efficiently.
- Respiratory pigments are essential for maintaining adequate oxygenation of the body's tissues.

Q.10 How does hemoglobin facilitate the transport of oxygen and carbon dioxide?**Ans. Hemoglobin Facilitate the Transport of Oxygen and Carbon Dioxide:**

Hemoglobin binds to oxygen in the lungs and releases it to the tissues.

- It also binds to carbon dioxide in the tissues and transports it back to the lungs.
- This process is essential for maintaining the balance of oxygen and carbon dioxide in the body.

Q.11 What are the causes and symptoms of sinusitis and otitis media?**Ans. Causes and Symptoms of Sinusitis and Otitis Media:**

- Sinusitis and otitis media are caused by viral or bacterial infections.
- Symptoms include nasal congestion, facial pain, and ear pain.
- The infections can cause inflammation and fluid buildup in the sinuses and middle ear.

Q.12 How are sinusitis and otitis media typically treated?**Ans. Sinusitis and Otitis Media Typically Treated:**

- Treatment typically involves antibiotics or antiviral medications to address the underlying infection.
- Symptoms can be managed with over-the-counter medications, such as decongestants and pain relievers.
- In some cases, surgical intervention may be necessary.

SELF-ASSESSMENT Chapter # 10

Total Mark: 30

(1 × 6 = 06)

Q.1 Encircle the correct option.**i. Which of the following structures is NOT directly involved in gas exchange?**

- (a) Alveoli (b) Bronchioles (c) Trachea (d) Pleura

ii. What is the primary cause of chronic bronchitis?

- (a) Viral infections (b) Bacterial infections
(c) Long-term exposure to pollutants such as cigarette smoke
(d) Genetic predisposition

iii. Which of the following is a lower Respiratory Tract Infection?

- (a) Sinusitis (b) Pharyngitis (c) Bronchiolitis (d) Laryngitis

iv. What is the primary function of surfactant in the lungs?

- (a) To warm the air we breathe to body temperature (b) To humidify the air we breathe
(c) To reduce surface tension in the alveoli (d) To filter out dust particles from the air we breathe

v. Which part of the respiratory system acts as the respiratory surface?

- (a) Larynx (b) Trachea (c) Bronchi (d) Alveoli

vi. What is the maximum amount of air that can be inhaled or exhaled during a respiratory cycle?

- (a) Tidal volume (b) Vital capacity
(c) Inspiratory reserve volume (d) Expiratory reserve volume

Q.2 Write short answers of the following questions.

(2 × 8 = 16)

- How does the structure of the respiratory surface facilitate gas exchange?
- What is the ventilation mechanism in humans, and how does it work?
- What is the role of hemoglobin in transporting oxygen and carbon dioxide?
- How are sinusitis and otitis media typically treated?
- How nasal cavity functions in filtering the inhaled air?
- What is the role of diaphragm during inhalation and exhalation?
- What are respiratory pigments, and what is their function in the body?
- How are sinusitis and otitis media typically treated?

Q.3 Extensive Questions.

(4 × 2 = 8)

- Describe the transport of oxygen through blood.
- Describe causes, symptoms and treatment of emphysema.