HUMAN BODY: THE DIGESTIVE SYSTEM

Learning outcomes

By the end of this theme, students will be able to:

- describe the organs of the digestive system and their functions
- describe how each nutrient is digested in the body

Warm-up

Encourage students to complete the *Get going* section given at the beginning of the chapter.

GUIDELINES TO TEACH

Introduction

Ask students:

Recap: *Can you name a single-celled organism that is capable of performing all the activities necessary for life*?

- Help students recall that organisms may consist of a single cell (**unicellular**) or many cells (**multicellular**).
- Reiterate that multicellular organisms are made up of various types of cells (with different shapes and sizes) performing different functions.
- Explain division of labour in multicellular organisms with suitable examples.

Ask students:

Which system helps the body for taking in oxygen and expelling carbon dioxide?

- Next, ask students to list all the body parts/organs that are involved in respiration, starting from the nose.
- Point out that these body parts are called **organs**, such as the nose, windpipe and lungs, which are involved with respiration.
- Explain that all such organs working together to accomplish a certain task is called **an organ system**.
- List all the major organ systems on the board, as given in the coursebook.

Ask students:

How is the human body able to perform different tasks?

Nutrition and nutrients

Ask students:

Why is food important?

What are nutrients? Where does our body get nutrients from?

- Explain about nutrients and how the body gets them.
- List out the types of nutrients, their functions and their sources, as given in the coursebook.
- With the help of the coursebook, distinguish between macro- and micronutrients.

Ask students:

Which nutrient forms a major part of our diet?

How are fats similar to carbohydrates?

What are vitamins and minerals known as?

Why is roughage important for digestion?

- Help students recall the importance of eating a **balanced diet**.

Ask students:

What major nutrients are missing in a diet of noodles and garlic bread?

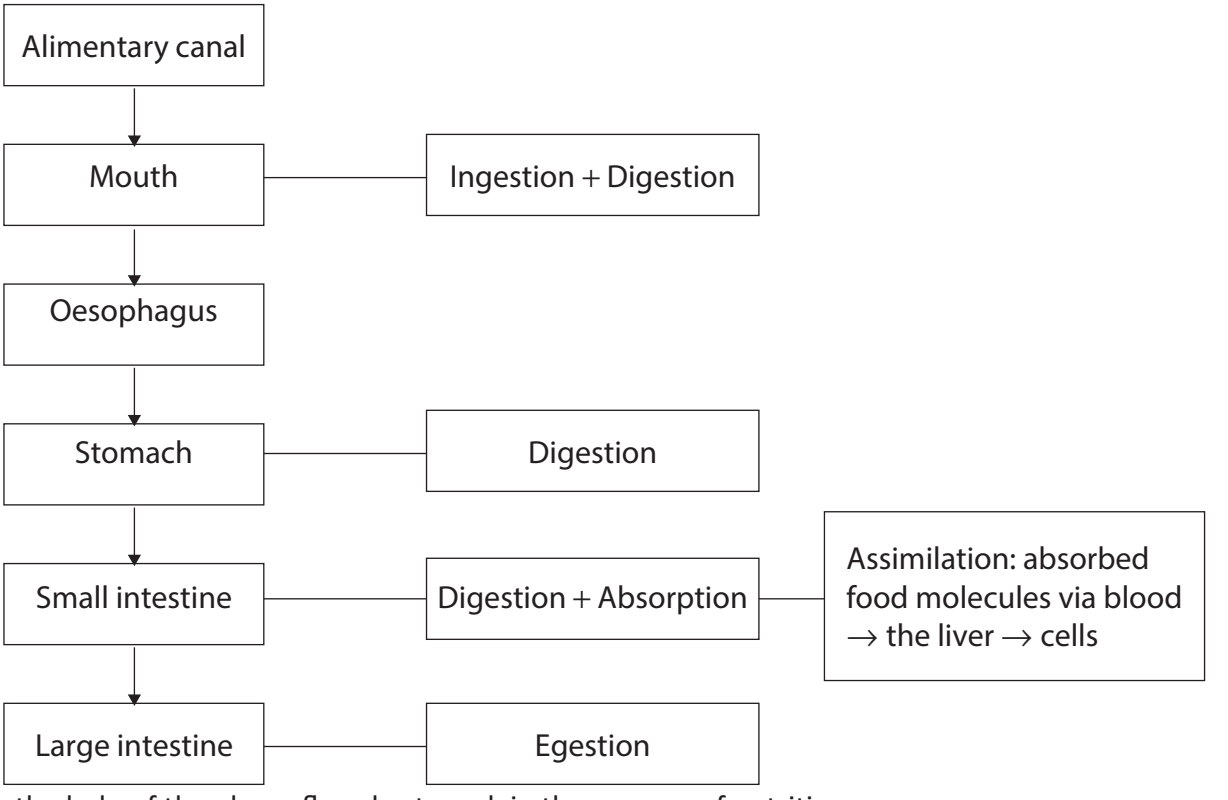
What happens when our body does not get to use the fat it stores?

Give the following instructions to students / Write on the board.
Activity: Prepare a list of food items you usually eat for breakfast. Find out the major nutrients present in them. Check whether you are missing out any essential nutrient. How do you plan to improve your breakfast? Make a PowerPoint Presentation and present it in class.

- Using 'Know more', explain the molecular structure of different nutrients.

The process of nutrition

- The five steps**:**



- With the help of the above flowchart, explain the process of nutrition.

The human digestive system

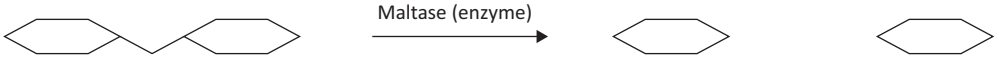
Ask students:

Do you know what happens to the food we eat?

How does our body get nutrients from the food we eat?

- Explain the term *digestion* and why food must be digested, as given in the coursebook (**Note**: *Explain that the food we take needs to be first broken down and converted into a simpler and soluble form in order to pass into the cell.*)
- With the help of the figures given below, explain what enzymes are and their role in the digestion process. *Enzymes are proteins that speed up chemical reactions. They can break large molecules into small molecules to speed up the digestion process*. *Enzymes are specific in their action,* that is, *enzymes that break down carbohydrate molecules cannot break down protein or fat molecules*.

a.

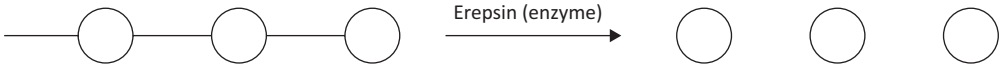


carbohydrate molecule (maltose) glucose molecule glucose molecule

b.

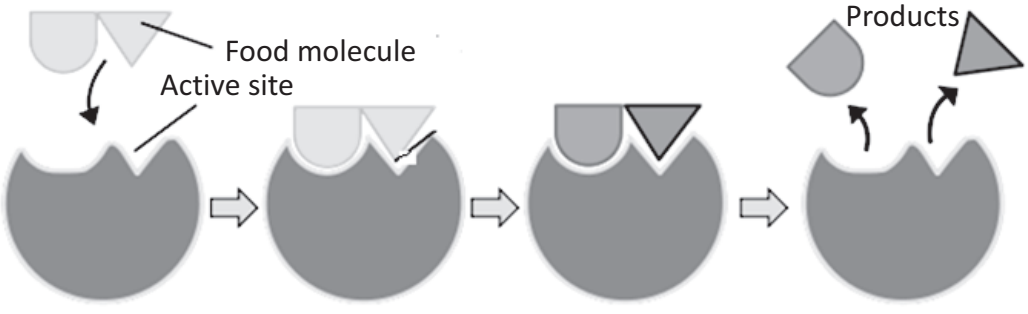
Fat molecule glycerol molecule fatty acid molecules

c.



Protein molecule amino acid molecules

Enzyme



Food molecule entering enzyme molecule | Enzyme-food complex | Enzyme-product complex | Products leaving active site of enzyme

How enzyme works

Enzyme induced model: Tim Vickers, Public Domain, Wikimedia Commons

Ask students:

What does the body produce to help in breaking down of food?

- **Alimentary canal**: Food is digested in the alimentary canal—mouth, stomach and small intestine.
- **Digestive glands**: The salivary glands, liver and pancreas are the associated glands that secrete enzymes into the alimentary canal to help in digestion of food.
- Using a well-labelled diagram of the alimentary canal, discuss the organs involved in the process of digestion in humans highlighting the role of each organ.

The alimentary canal

The mouth

Ask students:

Can you recall the path of food in our digestive system?

- List out the various parts of the mouth that participate in the process of digestion, pointing out their respective roles.
- Differentiate between the two kinds of digestion occurring in the mouth.
- *The teeth***:** Explain the role of teeth and the reason for humans possessing all four kinds of teeth.
- Describe the different types of teeth and their role in breaking down different category of food.
- With the help of the activity '***Studying your teeth***', ask students to identify the different types of teeth. Ask them to record their findings.
- Explain the structure of the teeth with the help of the figure, given in the coursebook (refer to '**Spotlight**').
- Discuss the consequences of not taking care of one's teeth.
- Differentiate between **mechanical** and **chemical** digestion.

Ask students:

Why are our teeth very important to us?

Name the layer next to the enamel. What kind of a layer is it and what does it cover?

What is plaque?

- *The tongue:* Describe the tongue.
- List out and explain its functions.
- Share with students the information given in the sections '**Know more**' and '**Spotlight**'.
- Use **Stop and Check** for a quick recap.

Give the following instructions to students / Write on the board.
Activity: Discussion: How important is dental hygiene? How can you keep your teeth healthy?

The oesophagus

- With the help of the figure, given in the coursebook, explain the significance of peristaltic movement at this stage.

- Point out that peristalsis also takes place in the stomach and intestines.
- To give students an idea about peristalsis, show the video available in the link —https://www.youtube.com/watch?v=rJS-Kh5wCQU
- Explain the reason for vomiting, as given in the coursebook (Know more).

The stomach

- Describe stomach and its constitution, as given in the coursebook. Share with students the information given in the section 'Know more'..

The small intestine

- With the help of the figure, given in the coursebook, describe the small intestine.
- List out its three parts.

The large intestine

- List out the three parts of the large intestine and mention its length.

The digestive glands

- Point out the importance of the **salivary glands**, **liver and pancreas** in digestion**.**
- These glands secrete digestive juices to different organs of the alimentary canal.

The salivary gland

- Point out the placement of salivary glands inside the mouth.
- Explain the role of the salivary glands in the digestion of food.
- Explain the functions of saliva, as given in the coursebook.

The liver

- Describe the liver and explain the role it plays in the digestion process.

The pancreas

- Describe the pancreas.
- With the help of the figure, given in the coursebook, point out its location.
- Explain its role in the digestion process.
- With the help of the figure, given in the coursebook, show the position of the pancreatic duct and the bile duct.

Process of digestion

Mouth

- Explain the role of saliva in the digestion of complex carbohydrates like starch (state that the process of digestion begins in the mouth).
- With the help of the activity '*Observing the action of saliva on food'*, given in the coursebook, explain the function of the starch-digesting enzyme amylase.

Stomach

- The gastric juice secreted by the glands in the stomach wall contains:
  (i) enzyme which digests proteins;
  (ii) dilute hydrochloric acid which provides an acidic medium for pepsin to carry out its function.
- Explain why carbohydrates are not digested in the stomach.
- *Role of mucus*: Point out why the stomach itself is not digested by the digestive juices secreted by it.
- Describe what happens to **chyme**.

Ask students:

Where does digestion begin?

What is the role of saliva in digestion?

What are the roles of acid and mucus in the stomach?

Small intestine

Duodenum

- List out the two juices that are secreted into the duodenum.
  (i) *Pancreatic juice*: List out the three enzymes made by the pancreas, and the type of food they digest.
  (ii) *Bile*: Explain how bile helps lipase to digest fats through **emulsification**. Emulsification is a type of mechanical digestion.

Jejunum

- Tell students about the importance of jejunum in the absorption of nutrients.

Ileum

- List out the enzymes present in the intestinal juice secreted by the glands present on wall of the ileum. Explain how food is further digested by these enzymes.
- Point out that these enzymes complete the digestion of food.
- List out the final products of digestion, as given in the coursebook.

Absorption

Small intestine: Explain how the small intestine is adapted for absorption of nutrients.

- the length
- presence of villi and microvilli
- villi contain blood capillaries
- thin walls, only one cell thick

- With the help of the figure of the villus given below, explain that the digested food molecules are small enough to pass through the wall of the small intestine into the blood

- Vitamins and minerals are also absorbed in the small intestine.

Large intestine: Point out that most of the water is absorbed into the blood. Explain what happens to the undigested food and the process of egestion.

Assimilation of nutrients

- Blood transports the digested food molecules to the liver and finally to the cells.
- Define assimilation as the process of making use of the absorbed nutrients by the body.
- Explain how the body makes use of the absorbed nutrients, as given in the coursebook.
- Recap on the digestive system.
- Summarise the journey of food along the various parts of the alimentary canal**.**

Ask students:

Name the parts of the alimentary canal where digestion takes place.

What is the role of liver in digestion?

Where does absorption of the digested food and water occur?

Summary of digestion in the alimentary canal

organ	juices secreted	location	enzymes present in juice	nutrients	product	other substances present in juices	functions of other substances
mouth	saliva	salivary glands	amylase	starch	maltose		
oesophagus	none						
stomach	gastric juice	glands present on wall of the stomach	pepsin	proteins	peptides	hydrochloric acid	acid medium for pepsin; kills microorganisms in food
duodenum	pancreatic juice	pancreas	amylase	starch	maltose		
			trypsin	proteins	peptides		
			lipase	fats	fatty acids and glycerol		
	bile	liver, stored in gall bladder	none				emulsify fats
jejunum	none						
ileum	intestinal juice	glands present on wall of the ileum	maltase	maltose	glucose		
			sucrase	sucrose	glucose and fructose		
			lactase	lactose	glucose and galactose		
			erepsin	peptides	amino acids		

HUMAN BODY: THE DIGESTIVE SYSTEM

Stop and check

1. True 2. False 3. False 4. True 5. False

Checkpoint

A. Choose the correct option.

1. c. pulp 2. b. maltose 3. c. liver 4. a. below the stomach
5. d. pepsin 6. b. oesophagus

B. Fill in the blanks.

1. alimentary canal 2. mouth, anus 3. cut, bite 4. salivary glands, pancreas and liver
5. oesophagus 6. mouth 7. stomach

C. Give reasons.

1. Different types of teeth help us to cut, tear and crush different foods into very small pieces. For example, incisors are used to cut and bite food.
2. Emulsification is the breaking down of large fat drops into smaller droplets for lipase to act upon fats.
3. The villi are richly supplied with blood vessels to help them absorb nutrients into the blood stream. The nutrients are then transported through the blood to all the cells in the body.

D. Differentiate between the following.

1.

Milk teeth	Permanent teeth
These are temporary	These are permanent
Start appearing around 6 to 8 months	Start appearing at the age of 6
Last only till the age of 11-12 years	They grow after 12 years of age
Premolars are absent in this set	They include premolars and molars (grow around age 18)

2.

Bolus	Chyme
Is a semi-solid mass of food that is formed after chewing and mixing with saliva	Partly digested thick paste of food that is formed after being churned with digestive juices by the stomach wall

3.

Amylase	Lipase
Amylase breaks down starch into maltose	Lipase breaks down emulsified fats into fatty acids and glycerol

E. Short-answer questions

1. A nutrient is a substance that the body needs to maintain itself and also to grow.
2. Carbohydrates, proteins and fats are called *macronutrients* as they are required in large quantities.
3. Starch is broken down into maltose, proteins to peptides and fats into fatty acids and glycerol.
4. An enzyme is a substance that speeds up a chemical reaction taking place within a cell. Enzymes are highly specific, and usually act on only one type of nutrients.
5. Muscles of the oesophagus contract and relax rhythmically to push food down into the stomach.
6. The anal sphincter is a circular muscle that keeps the anus closed.

F. Long-answer questions

1. The different types of teeth are *canines*, *incisors*, *premolars* and *molars*.
   i. *Incisors*: Their sharp edge helps to cut and bite food.
   ii. *Canines*: Their pointed edge is used to grip and tear food such as meat.
   iii. *Premolars and molars*: The flat surface of premolars and molars are used to crush and grind food.
2. Diagram: Refer to the coursebook.
3. Saliva has many functions—
   i. The amylase in saliva breaks down starch into maltose.
   ii. It helps to bind the food particles to form the bolus, which is easy to swallow.
   iii. It helps clean the mouth and teeth.
   iv. It helps to keep the mouth and the tongue moist for easier swallowing and speaking.
4. The walls of the stomach have glands that secrete *gastric juice*. The gastric juice consists of the following—
   i. The digestive enzyme *pepsin* breaks down complex proteins into simpler proteins.
   ii. *Hydrochloric acid* activates pepsin and also kills microorganisms that enter along with food.
   iii. *Water* acts as a medium for the action of the acid and the enzymes.
5. The liver secretes *bile* which is released into the duodenum when needed. Bile helps in

emulsification of fat, that is, breaking down large drops of fats into smaller droplets. This helps the fat-digesting enzyme *lipase* to work faster and easier on fats.

6. The pancreatic juice contains the enzymes *amylase*, *trypsin* and *lipase*.

$$\text{starch} \xrightarrow{\text{amylase}} \text{maltose}$$

$$\text{proteins} \xrightarrow{\text{trypsin}} \text{peptides}$$

$$\text{fats} \xrightarrow{\text{lipase}} \text{fatty acids + glycerol}$$

7. Undigested food moves slowly through the large intestine. Most of the water is absorbed to leave behind the semi-solid faeces. The faeces are stored in the rectum till the next bowel movement. The rectum opens to the outside through the anus. The anus has a circular muscle called the anal sphincter which keeps the anus closed. When this muscle relaxes, the faeces are expelled out of the body. This process is called *egestion*.

HUMAN BODY: THE DIGESTIVE SYSTEM

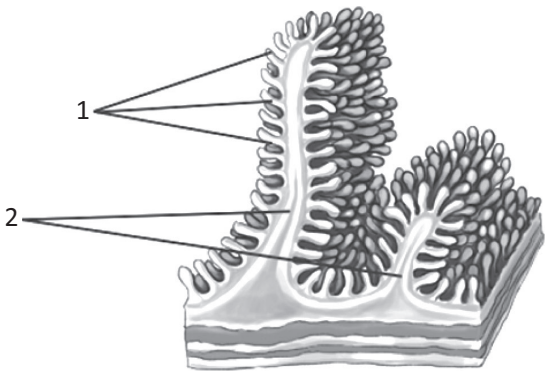
A. Process of nutrition: re-arrange the order to get the correct order of the process of nutrition.

1. The process by which food is broken down into simple substances
2. The process by which nutrients from the digested food are absorbed by the body
3. The process by which an organism takes in its food
4. The process by which the absorbed food is utilised by the body for energy, growth, repair and so on
5. The process by which substances that are not digested or absorbed are thrown out of the body

Ans: 3, 1, 2, 4, 5

B. Observe the figure and answer the questions.

1. Identify 1 and 2 in the figure given.
2. Where are they found in the human body?
3. Mention their function.



Ans: 1. microvilli 2. villi

2. They are found along the inner lining of the small intestine.

3. They have large surface area for the absorption of digested food. They are also supplied with capillaries for the absorption of nutrients into the bloodstream.

C. Answer the questions.

1. What is dental plaque?

   Ans: Bacteria present in the mouth together with saliva and leftover pieces of food form a sticky film over the teeth called plaque.

2. How are cavities formed?

   Ans: The bacteria present in the mouth convert the leftover food into acid. This acid corrodes or damages the enamel of the teeth, leading to cavities or caries.

3. What is the role of mucus in the stomach?

   Ans: Gastric juice contains hydrochloric acid and pepsin that can damage the inner lining of the stomach. The mucus prevents the stomach from being damaged by the acid and the enzyme pepsin.

4. Where are enzymes produced?

   Ans: Enzymes are produced in the mouth, stomach, pancreas and small intestine.

RESPIRATORY SYSTEM

Learning outcomes

By the end of this theme, students will be able to:

- describe the organs of the respiratory system and their functions
- describe the mechanism of breathing
- explain the difference between respiration and breathing
- name some common diseases of the respiratory system

Warm-up

Encourage students to complete the *Get going* section given at the beginning of the chapter.

Ask students:

Why do we need energy?

How does the food we eat get converted to energy? (Respiration releases energy from food.)

Why do we feel hungry after vigorous exercise? (We use up a considerable amount of energy when we exercise vigorously. This energy comes from the digested food stored in the body. The body needs to replace the food that was used up to provide energy, so vigorous exercise makes us feel hungry.)

- Define *respiration* and give a small introduction on it making clear the release of energy.

The human respiratory system

- Display a coloured labelled diagram of the respiratory system and frequently refer to it during teaching.
- With the help of the chart, list out the different parts of the respiratory system.
- Draw the given flowchart on the board. Use it, to show the path of air during respiration.
- The path taken by inhaled air—

  nasal cavity → pharynx → trachea → bronchi → bronchioles → alveoli

  lungs

- Exhaled air goes out through the same path in the reverse direction.
- To give students an idea about the path taken by inhaled air, show the video available in the link—https://www.youtube.com/watch?v=zRv5tNCMpyY

Ask students:

Which gas is formed in the process of respiration?

Organs of the respiratory system

The nose

- Ask students to identify this part of their respiratory system.
- Point out the role of mucus and hairs inside the nasal chambers/nasal passages.
- List out the other two functions of the nasal passages.
- Explain the reason for sneezing (Know more).

Ask students:

What is the function of the small hairs that line the nasal cavity?

The pharynx

- Locate pharynx in the diagram.
- Show them that it is a common region to the digestive and respiratory systems and leads to larynx.

The larynx

Ask students:

Do you know why elders ask you not to talk while you eat?

- To give students an idea about how epiglottis prevents food from entering the lungs, show the video available in the link—https://www.youtube.com/watch?v=pNcV6yAfq-g
- Explain why the larynx is called the voice box.
- Tell students that when we talk, the epiglottis may open to expel air to produce sound. If there is food in the larynx at the same time, food may enter lungs and produce choking.

The trachea

- Identify trachea in the diagram.
- Tell students that it is also called the windpipe.
- Explain its placement with respect to the alimentary canal, and how it is prevented from collapsing during exhalation.

The bronchi

- Show students how the trachea divides into bronchi in the diagram.
- Replay the video and identify bronchioles inside the lungs.
- Explain that the bronchioles end in alveoli.

The lungs

- Identify this part of the respiratory system in the diagram.
- Point out how the lungs are protected and the disparity between the right and left wing of the lungs.

- Explain the role of *pleura* and how they protect the lungs.
- Mention the role of the *diaphragm*.
- Explain how the structure of the lungs enables rapid exchange of gases between blood and the lungs.

Ask students:

How does the diaphragm help in breathing?

The alveoli

- Explain the structure/adaptation of alveoli, that is, specifically equipped for exchange of gases (*large surface area*, *thin walls*, *surrounded by capillaries*).

Ask students:

What are alveoli?

Breathing to respiration

- Tell students that breathing is just one component of respiration.
- List out all the components of respiration and explain each, one by one.

How air enters and leaves the lungs

Mechanism of breathing

- Explain the processes of *inhalation* and *exhalation*, as given in the coursebook.
- Using the table, given in the coursebook, do a comparison between these two processes.
- Demonstrate the activity '*To study the role of the diaphragm*', given in the coursebook.
- Guide students to do the following activity '*Observing the effect of exercises on the rate of breathing*', given in the coursebook. Let them note down their findings.
- Use **Stop and Check** for a quick recap.

Exchange of gases

- **Tell students**: Blood is the medium for transport of oxygen and carbon dioxide.
- Explain why diffusion happens and how this process enables blood to absorb oxygen from inhaled air (oxygen diffuses across the walls of the alveoli into the blood capillaries).
- Explain how this oxygen-rich blood is sent to the heart and the heart pumps it to various parts of the body.
- Discuss how oxygen is transported to every cell of the body.
- In the cells, oxygen breaks down glucose to release energy, carbon dioxide and water.
- Blood, rich in carbon dioxide from the cells, is sent to the lungs by the heart.
- Once again diffusion process takes place—this time it is that of carbon dioxide from the blood to the air in the alveoli, which is then exhaled out through the nose.

Ask students:

Where does gas exchange take place in humans?

Respiration

- Define *respiration*.
- Explain why it is called internal/cellular respiration.
- Distinguish between aerobic and anaerobic respiration, as given in the coursebook.
- Write down the oxidation reaction on the board and explain the energy liberation process.
- Encourage students to do the following activity ' Observing the changes during breathing' , given in the coursebook. Allow them to explain their finding. 

Give the following instructions to students.

Activity: Daily perform slow deep breathing for ten minutes and check for any change in your energy level. Can you identify the reason for the change?

Ask students:

What is the purpose of respiration?

Why does oxygen diffuse into red blood cells?

Common respiratory diseases

- List out the common respiratory diseases as given in the coursebook.
- Discuss the cause, symptoms and treatment of these diseases.
- Mention about **BCG vaccine**.
- Discuss the information given in the 'Eco corner' and ask students to come up with ideas to prevent/ slow down atmospheric pollution.

Give the following instructions to students / Write on the board.

Activity: Find out the size of the lungs versus function in various animals. Make a PowerPoint presentation to your class.

Activity: Find out the chemicals present in tobacco. How does each chemical affect the respiratory system? Make a PPT on your findings and present it to your class.

THE RESPIRATORY SYSTEM

Stop and check

1. epiglottis 2. voice box 3. vocal chords 4. bronchi 5. alveoli
6. inhalation and exhalation

Checkpoint

A. Choose the correct option.

1. c. windpipe 2. c. nose → pharynx → trachea → bronchi → bronchioles → alveoli
3. b. nitrogen 4. b. carbon dioxide 5. d. asthma

B. Fill in the blanks.

1. glucose 2. pharynx 3. diaphragm 4. diffusion 5. BCG

C. Differentiate between the following.

1.

Breathing	Respiration
It is a physical process in which oxygen is taken in and carbon dioxide is given out	It is a chemical process in which oxygen combines with glucose to release energy
It occurs outside the cell	It occurs inside the cell

2.

Aerobic respiration	Anaerobic respiration
Occurs in the presence of oxygen	Occurs in the absence of oxygen

D. Short-answer questions

1 Oxygen is used during respiration to breakdown food (*glucose*). Energy is released in this process along with carbon dioxide and water.

2 The epiglottis covers the larynx when food is being swallowed to prevent it from entering the lungs.

3 The fluid between the pleural membranes cushions and protects the lungs from injury along with the ribcage.

4 Haemoglobin present in the red blood cells carries oxygen to all parts of the body.

5 Gas exchange takes place in the alveoli in the lungs.

6 A bronchodilator is a medicine that opens up the airways to allow free flow of air.

7 Bronchitis is an infection in which the lining of airways (bronchial tubes) gets swollen. This narrows of the air passages, resulting in coughing and difficulty in breathing. It is caused by bacteria or viruses and sometimes by pollutants such as smoke.

8 Pneumonia is treated with antibiotics, rest and plenty of fluids.

E. Long-answer questions

1. Diagram: Refer to the coursebook.
2. During *inhalation*, the ribcage moves upwards and outwards while the diaphragm contracts and moves downwards. Due to this movement, the volume of the chest cavity increases and the lungs expand. Thereby, the air pressure inside the lungs drops causing the atmospheric air to rush in. During *exhalation*, the ribcage moves downwards and inwards and the diaphragm relaxes and moves up. The volume of chest cavity decreases and the size of the lungs reduces. Thereby, the air pressure inside the lungs rises causing air to rush out of the lungs.
3. During cellular respiration, food (glucose) is broken down in the presence of oxygen to release energy, carbon dioxide and water. So, the percentage of carbon dioxide in the cells is higher than in the blood present in the capillaries, causing it to diffuse from the cells into the blood. Now, the carbon dioxide-rich blood is taken to the lungs where carbon dioxide diffuses into the alveoli from the capillaries and is exhaled out.
4. Diffusion of gases takes place through the capillaries surrounding the alveoli (lungs). During breathing, oxygen enters the alveoli. The concentration of oxygen (21%) is higher in the alveoli than in the capillaries surrounding them. Hence, oxygen diffuses out of the alveoli into the capillaries. During cellular respiration, carbon dioxide is produced in the cells. Carbon dioxide diffuses out of the cells into the capillaries. Blood has high concentration of carbon dioxide. Carbon dioxide is carried by the blood to the lungs. Thus, blood present in the capillaries has high concentration of carbon dioxide than the alveolar air. So, carbon dioxide diffuses out of the blood into the alveoli.
5. Cellular respiration or internal respiration is the breakdown of food (glucose) to release energy along with carbon dioxide and water. This is a chemical process that happens inside the cells.
6. i. *Asthma* is caused by substances which irritate the respiratory passages. The airways become swollen and prevent easy flow of air through them. This makes breathing difficult. The person feels tightness in the chest, shortness of breath or wheezing. *Treatment*: Bronchodilators are used to treat asthma. They are medicines that open up the airways to allow free flow of air. They are given directly into the air passages using an inhaler or a puff.

   ii. *Tuberculosis* (*TB*) is a disease caused by a particular kind of bacterium. The lungs become swollen and start bleeding. The patient has fever, night sweats, chest pain and sudden weight loss. The patient also has a continuous cough that brings up blood. *Treatment*: Tuberculosis is treated with antibiotics, which may need to be taken for up to six months without a break.

   Tuberculosis can be prevented by taking the BCG vaccine.

THE RESPIRATORY SYSTEM

A. Name the following.

1. The other name of larynx
2. The flap-like structure that protects the entrance of the larynx
3. The two branching tubes of trachea
4. The membrane that covers the lungs
5. The muscular sheet that separates the chest cavity from the abdominal cavity

Ans: 1. voice box 2. epiglottis 3. bronchi 4. pleura 5. diaphragm

B. Answer the questions.

1. Why does our body need oxygen?

   Ans: We need energy to do all the activities. We get energy from food. Oxygen is required for breaking down glucose (food) to release energy.

2. Why do alveoli have thin walls and are richly supplied with capillaries?

   Ans: Alveoli have thin walls and are richly supplied with capillaries so that gas exchange between the blood and the inhaled air can take place by diffusion.

3. Why do we feel hungry after vigorous exercise?

   Ans: We use up a considerable amount of energy when we exercise vigorously. This energy comes from the digested food (glucose) stored in the body. The body needs to replace the food that was used up to provide energy, so vigorous exercise makes us feel hungry.

4. Briefly describe the causes, symptoms and treatment of tuberculosis

   Ans: *Cause*: Tuberculosis (TB) is caused by a particular bacterium.

   Symptoms: The lungs become swollen and start bleeding. The patient has a fever, night sweats, chest pain and sudden weight loss. The patient also has a continuous cough that brings up blood.

   Treatment: Tuberculosis is treated with antibiotics, which may need to be taken for up to six months without a break. It can be prevented by taking the BCG vaccine.

THE CIRCULATORY SYSTEM

Learning outcomes

By the end of this theme, students will be able to:

- describe the components of blood and types of blood vessels
- describe the organs of the circulatory system and their functions
- explain the process of circulation of blood
- describe how the heart can be kept healthy

Warm-up

Encourage students to complete the *Get going* section given at the beginning of the chapter.

- Give a small introduction on the circulatory system highlighting the role of blood as a carrier of energy and oxygen.
- Define circulatory system as the transport system of the body.

The human circulatory system

- Explain the need for a transport system in multicellular organisms.
- List out the components of the human circulatory system, as given in the coursebook.

Ask students:

What happens if the circulatory system does not function properly?

Blood

- *Plasma*: Describe plasma, its constitution and its function.
- *The corpuscles*: list out the three types of corpuscles.
  - **Red Blood Corpuscles (RBCs) or erythrocytes**: using the figure, given in the coursebook, explain the shape of RBCs and share the other features and their ability to carry oxygen. Mature RBCs do not have a nucleus.
  - **White Blood corpuscles (WBCs) or leukocytes**: describe the shape and other features of WBCs. Compare their features with those of RBCs. Point out their main function.
  - **Platelets or thrombocytes**: Specify the relative abundance of platelets and their role in forming blood clots. They do not have a nucleus.
- List out the ideal concentration of these cells in the blood from the section '*Know more*'.

Ask students:

What is the role of plasma in the blood?

What will happen if the WBC count in the blood falls below normal?

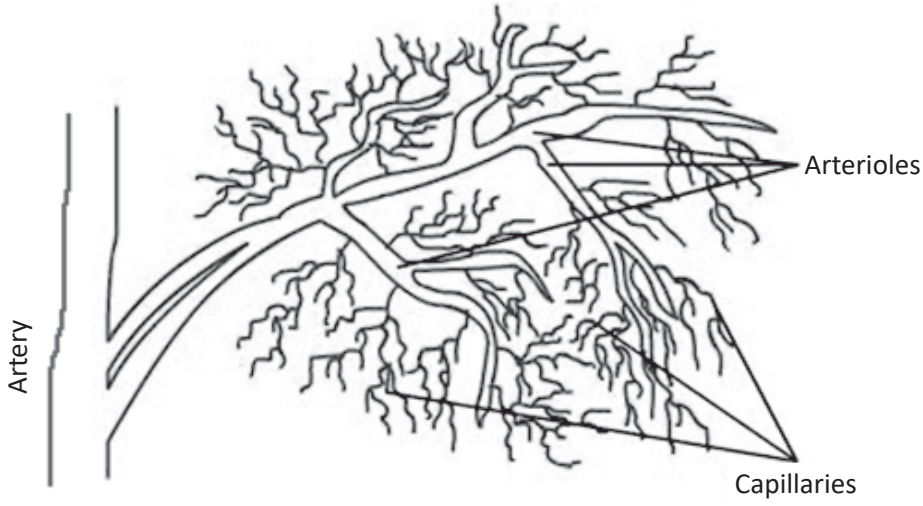
Why is it important to have platelets in blood?

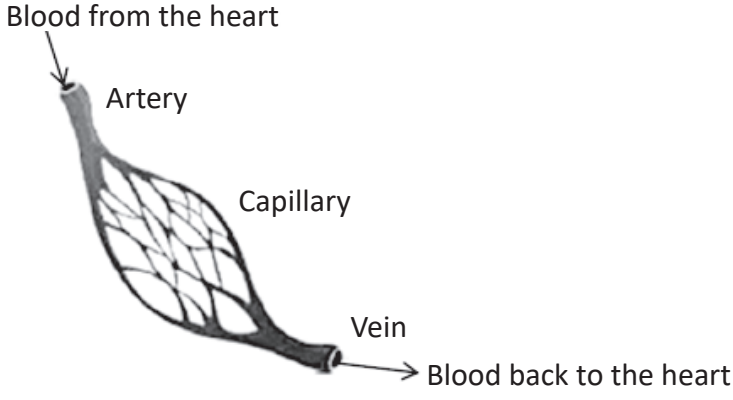
Functions of blood

- List out the three main functions of blood.
  - Explain its role as a medium for the transport of nutrients, oxygen, and metabolic wastes (carbon dioxide and urea) for the smooth functioning of the body.
  - Describe how blood protects the body by destroying the disease-causing germs.
  - It prevents excessive bleeding by forming blood clots.
  - Tell students how blood dissipates heat produced in the body by distributing it all over the body.

Blood vessels

- Explain what blood vessels are.
- With the help of the figures, given in the coursebook, list out the three types of blood vessels.
  - **Arteries:** describe their structure, features and location.
  - **Capillaries:** With the help of the given diagrams, explain how arteries branch into arterioles and capillaries.





Note: Explain that the exchange of substances between the blood and the cells can only occur through capillaries.

- **Veins:** Explain the type of walls veins have, and how the back flow of blood is prevented in veins (refer to *Know more; have valves*).

- **Note:** Point out that arteries usually carry oxygen-rich blood, while veins usually carry oxygen-poor blood. However, their roles are reversed in pulmonary circulation.
- **Review:** Distinguish between arteries, veins and capillaries with respect to their location, structure and function.

Ask students:

Why do arteries have thick walls?

Where do substances get exchanged between the blood and the cells?

Which blood vessels carry blood away from the heart?

The heart

- With the help of the figure, given in the coursebook, describe the heart, its position, structure and function.
- Tell students about the cardiac muscles and their amazing ability to work a life time without ever stopping!

Internal structure of the heart

- With the help of the figure, point out septum and explain its significance.
- Point out the division of each of these halves into an auricle (atrium) and a ventricle, forming four compartments in the heart and the difference in their constitution.
- Distinguish between the actions of the right side and left side of the heat.
- Mention about AV valves. To give students an idea about how the heart works, show the video available in the link—https://www.youtube.com/watch?v=yGlFBzaTuoI

*Blood vessels attached to the heart***:**

- Point out the major blood vessels in the figure, given in the coursebook.
- Explain the functions of the superior vena cava, inferior vena cava and pulmonary veins.
- Discuss the functions of the pulmonary arteries and the aorta. Mention about the valves present at the points where these arteries leave the ventricles.
- Distinguish between the functions of the right and left part of the heart.
- Share the information from '**Know more**' and '**Career Watch**'.
- Use **Stop and Check** for a quick recap.

Blood circulation through the heart

- Using the figure, given in the coursebook, explain the circulation of blood in human body. Explain about why the circulation of blood inside the heart is known as *double circulation*.

- Distinguish between *pulmonary* and *systemic* circulation.
- To give students an idea about how the heart works, show the video available in the link— https://www.youtube. com/watch?v=s2OIaXZZI0w

Heart beat and pulse

- Explain what the heartbeat is and what happens during the course of one heartbeat.
- Explain heartbeat and why exercising / climbing stairs increases the rate of heartbeat.
- Ask students to try to listen to heartbeat using a stethoscope.
- With the help of the activity '*Feeling the pulse*', given in the coursebook, guide students how to check their pulse and ask them to correlate heart rate and pulse rate.
- Share the information given in the section '*Know more*'.

Blood pressure

- *Blood pressure: the force exerted by blood on the walls of the arteries.*
- Tell students about sphygmomanometer, hypertension and hypotension. (Refer to ' **SciTech**', given in the **coursebook**).

Blood groups

- Explain how blood is classified into four types according to RBC protein (antigens).

Blood transfusion

- Explain about blood transfusion and the importance of blood group in blood transfusion.
- Make a chart of the groups that can donate blood to other groups.
- Mention about blood bank.

Give the following instructions to students / Write on the board.

Activity: Discussion: Is blood donation good or bad? Is it safe to donate blood? What are the precautions to be taken during and after blood donation?

Maintaining a healthy heart

- List out and explain the different measures to be taken for maintaining a healthy heart.

THE CIRCULATORY SYSTEM

Stop and check

1. True 2. True 3. True 4. False

Checkpoint

A. Choose the correct option.

1. c. lungs 2. a. septum 3. b. pulmonary vein 4. c. i and iv

B. Match the words in the two columns.

1. iv 2. vi 3. ii 4. v 5. iii 6. i

C. Fill in the blanks.

1. circulatory system 2. plasma, corpuscles 3. haemoglobin 4. antibodies
5. thrombocytes 6. atrium, auricle 7. atrio-ventricular 8. sphygmomanometer

D. Differentiate between the following.

1.

RBCs	WBCs
Red-coloured blood cells	Colourless blood cells
Bi-concave in shape	Round in shape; larger than RBCs
Mature ones do not have nucleus	Have a nucleus
Carry oxygen to all the body cells	Defend the body against germs

2.

Artery	Vein
Carries blood away from the heart	Carries blood towards the heart
Has thick, muscular, elastic wall	Has thinner wall
Does not have valve	Has valve
Usually found deep in the body	Found superficially
Carries oxygen-rich blood (exception: pulmonary artery)	Carries carbon dioxide-rich blood (exception: pulmonary vein)

3.

Atria	Ventricles
Upper chambers; smaller and have thin muscular walls	Lower chambers; larger and have thick muscular walls
Receive blood from the lungs and the rest of the body through veins	Send out blood to the lungs and rest of the body through arteries

E. Short-answer questions

1. Arteries have thick, muscular, elastic walls that help them withstand the force of the blood flowing through them.
2. Capillaries have thin walls made of one layer of cells. This thin wall allows them to exchange gases, nutrients and waste easily between the blood and the cells.
3. Valves stop blood from flowing backwards.
4. The heart is made of cardiac muscle, a special kind of muscle that can contract and relax continuously without any rest.
5. Deoxygenated blood is sent from the heart to the lungs where gas exchange takes place and carbon dioxide is exhaled out. Blood rich in oxygen is then brought to the heart, from where it is pumped out to the rest of the body.

F. Long-answer questions

1. Blood is made up of two components—
   i. the liquid part called *plasma*
   ii. blood cells called *corpuscles*

- Plasma is pale yellow in colour. It contains mainly water (90%). Many substances, such as proteins, glucose, minerals, hormones and waste products are dissolved in it (10%).
  - It transports nutrients to every part of the body. It also transports hormones and enzymes.
  - It collects waste products and carbon dioxide from every part of the body.
- There are three kinds of corpuscles in human blood.
  - *Red blood corpuscles* (RBCs): also called erythrocytes. They are biconcave in shape with a flattened centre. RBCs do not have a nucleus. They are red due to the iron-containing pigment called *haemoglobin*. They carry oxygen from the lungs to every cell in the body. Iron helps haemoglobin carry oxygen. They are the most abundant cell in the blood.
  - *White blood corpuscles* (WBCs): also called leukocytes. They are round in shape and fewer in number than RBCs. They are larger than the RBCs, colourless (do not contain haemoglobin) and have a nucleus. They do not transport substances. WBCs protect the body from infections. They engulf germs and digest them, or they produce special proteins called antibodies which help to destroy germs.
  - *Platelets*: also called thrombocytes. These are colourless and smallest in size. They do not have nucleus. They too do not carry substances. They make blood clot, thereby, help in healing wounds.

2. Blood has three main functions—transport, protection and regulation.

   i. *Transport of substances*: It transports oxygen from the lungs to all the cells in the body. It carries carbon dioxide from every cell in the body to the lungs. It carries waste products to the kidneys so that they can be excreted. It transports nutrients to every cell in the body.
   ii. *Protection*: It provides immunity by killing disease-causing germs that enter the body.
   iii. *Clotting*: It prevents blood loss by forming blood clots.
   iv. *Regulation*: It helps to regulate the temperature of the body by distributing heat produced during chemical reactions in the body.

3. Diagram: Refer to the coursebook.
4. Deoxygenated blood from the body enters the right atrium of the heart through the superior vena cava and the inferior vena cava. The right atrium contracts and pushes the blood into the right ventricle. The right ventricle contracts and pushes the blood into the pulmonary artery. The pulmonary artery carries the blood to the lungs. Following gas exchange in the lungs, oxygenated blood is carried from the lungs to the left atrium by the pulmonary veins. The left atrium contracts and pushes the blood into the left ventricle. The left ventricle contracts and pushes blood into the aorta, which distributes the blood to the rest of the body.
5. The pulse can be felt at any point in the body where an artery is found close to the surface of the skin and lies against a bone. There are several pulse points in the body. Example: To measure your own pulse, place the index finger and middle finger of one hand on the wrist of the other hand. You can feel a small throbbing movement under the fingers at the wrist. This is the pulse.
6. During transfusion, the correct blood group has to be transfused. People cannot be given blood from just any person. If the incorrect blood group is transfused, the blood may clot and is fatal.

   Given below are the blood groups that can be accepted by certain blood groups.

   A person with the *A blood group* can accept blood of type *A* or *O*.

   A person with the *B blood group* can accept blood of type *B* or *O*.

   A person with the *AB blood group* can accept blood of any type and is thus called a *universal recipient*.

   A person with the *O blood group* can accept only blood of type *O*, but can donate blood to anyone and hence, this person is a *universal donor*.

Think and answer

1. Toast (bread)—starch (carbohydrates); Butter—fats; Omelette (egg)—proteins

Food item	Organ	Enzyme	Action of enzyme and the end products
Bread	Salivary glands (mouth)	Amylase	starch → maltose
Egg	Stomach	Pepsin	proteins → peptides
Bread, egg, butter	Duodenum	Amylase Trypsin Lipase	starch → maltose proteins → peptides fats → *fatty acids and glycerol*
Egg, bread	Ileum (small intestine)	Erepsin Maltase	peptides → *amino acids* maltose → *glucose*

2. When there is loose motion, the large intestine is infected and hence is not able to absorb the excess water from food. Hence, loose motion.
3. If blood were not sent to the lungs during circulation, gas exchange would not take place. Oxygen supply to the cells will not take place. Without oxygen, cellular respiration or glucose breakdown for energy will not happen.
4. The oxygenated blood from the lungs is brought to the heart so that it can be pumped to the rest of the body.
5. Our muscle cells use the oxygen faster to break down glucose during exercises. In order to increase the rate of oxygen intake, we breathe faster the heart beats faster.

THE CIRCULATORY SYSTEM

A. Fill in the blanks.

1. Red blood cells are _____ in shape and do not have a _____ .
2. Some of the WBCs produce special proteins called _____ which help to destroy germs.
3. _____ are thin-walled blood vessels.
4. The heart is divided into two by a muscular wall called the _____ .
5. The _____ valves regulate the flow of blood from the atrium to the ventricle.
6. The _____ _____ are the only veins that carry oxygenated blood.
7. The _____ carries oxygenated blood from the left ventricle to the rest of the body.
8. One cycle of contraction and relaxation of the heart makes up a _____ .
9. The force exerted by the blood on the walls of the arteries is called _____ _____ .
10. A person with the _____ blood group can give blood to a person of any blood type.

Ans: 1. bi-concave, nucleus 2. antibodies 3. capillaries 4. septum
5. atrio-ventricular valve or AV 6. pulmonary veins 7. aorta 8. heartbeat
9. blood pressure 10. O

B. Differentiate between the following.

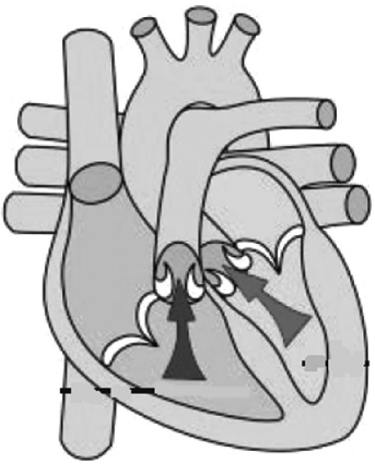
1. Pulmonary veins and pulmonary arteries.
   Ans: The pulmonary veins bring oxygenated blood from the lungs to the heart (left auricle). The pulmonary arteries carry deoxygenated blood from the right ventricle to the lungs.
2. Pulmonary circulation and systemic circulation.
   Ans: The circulation of blood between the lungs and the heart is called *pulmonary circulation*. The circulation of blood between the heart and the rest of the body is called the *systemic circulation*.

C. Answer the questions.

1. What is a double circulatory system?
   Ans: The blood circulates through the heart twice on one complete journey through the body.
2. Which side of the heart contains oxygenated blood?
   Ans: The left side of the heart contains oxygenated blood.
3. Where are the atrio-ventricular valves found? Mention their function.
   Ans: Atrio-ventricular valves are present between the auricles and ventricles. These valves stop blood flowing from the ventricles back to the auricles.
4. Why do the auricles have thinner walls than the ventricles?
   Ans: The auricles receive blood either from the lungs or the rest of the body whereas the ventricles pump blood out of the heart to the entire body.

5. Identify the image that depicts contraction of the atria and the image that depicts contraction of the ventricles.

1.



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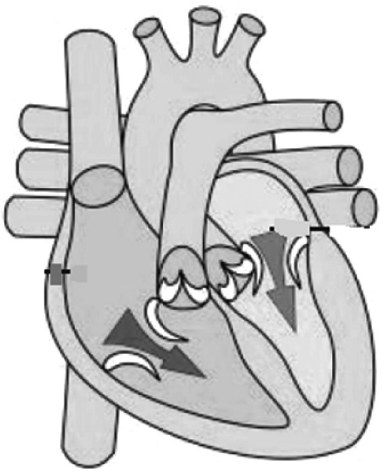
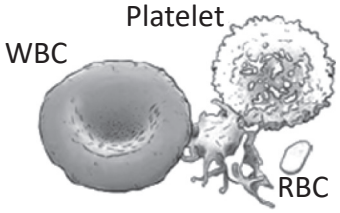


Ans: 1. Contraction of the ventricles 2. Contraction of the atria

6. Correct the labels in the figures given.

1.



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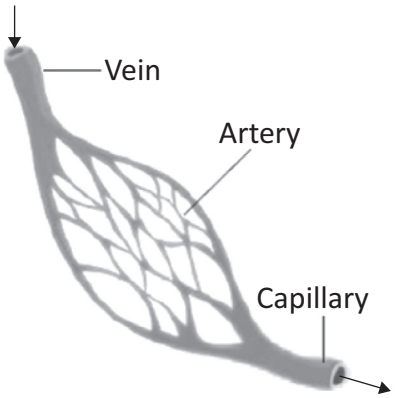
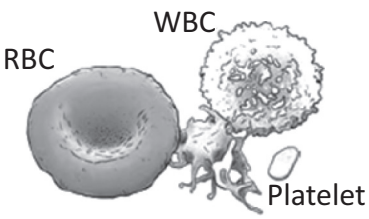


Ans:

1.



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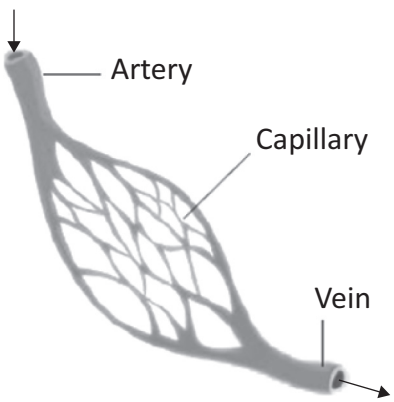


HUMAN BODY: THE DIGESTIVE SYSTEM

1. Arrange the following statements in the correct order of occurrence in the human body. Arrange the sentences in the correct sequence by writing numbers 1–5 in the boxes provided.

a. The swallowed food enters a long, muscular, pipe-like organ called the oesophagus. ☐

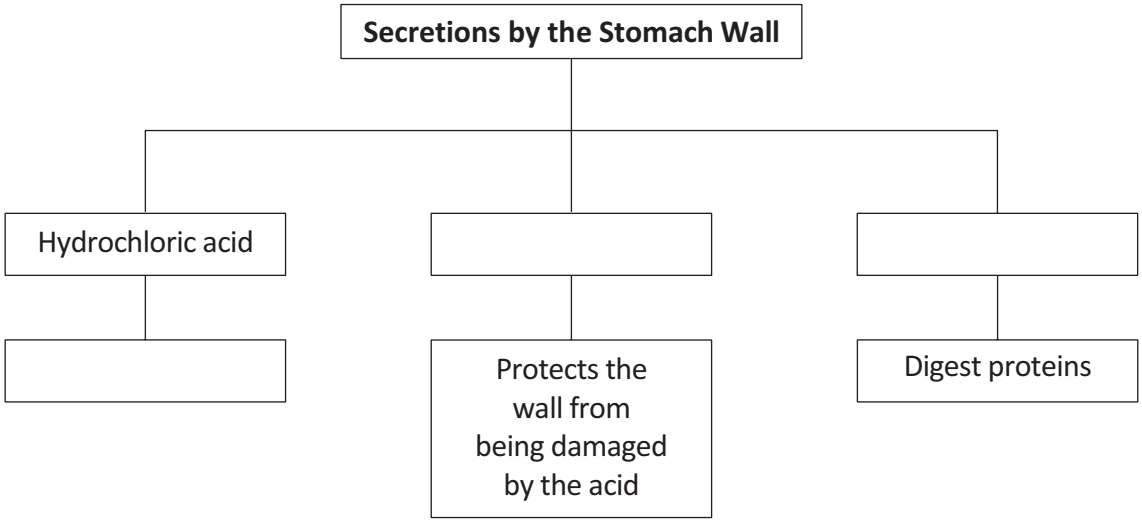
b. Bile breaks down fat drops into tiny droplets. ☐

c. Sugars and amino acids are absorbed into the bloodstream. ☐

d. The acid kills bacteria and other germs that are in the swallowed food. ☐

e. The tongue helps to roll the chewed food into a ball, which is swallowed. ☐

2. Complete the chart.



3. Name the part of the alimentary canal involved in the functions given.

a. Pushing of food down to the stomach _____

b. Absorption of water from the undigested food _____

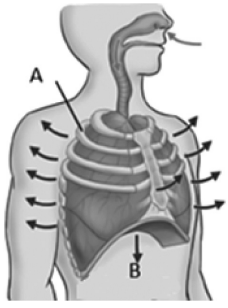
c. Killing of bacteria that enter with food _____

d. Beginning of digestion of food _____

e. Egestion of undigested food _____

THE RESPIRATORY SYSTEM

1. Label the structures A and B in the figure given.



A: _____

B: _____

a. Explain the role of the structures A and B during inhalation.

_____

_____

2. Given below are events in the process of exhalation. Number them in the correct order.

a. The air pressure inside the lungs rises and carbon dioxide is forced out of the lungs. ☐

b. The volume of the chest cavity decreases and the lungs contract. ☐

c. The diaphragm relaxes and moves up and the ribcage moves downwards and inwards. ☐

3. Name the following.

a. When respiration occurs in the presence of oxygen: _____

b. The molecule present in human blood that carries oxygen: _____

c. The tissue that prevents the trachea from collapsing: _____

4. The table shows the comparison of inhaled and exhaled air. Give reasons for the difference.

Constituent of air	Inhaled air	Exhaled air	Reason for difference
a. Oxygen	21%	16%	
b. Carbon dioxide	0.04%	4%	
c. Water vapour (saturation)	low	high	

THE CIRCULATORY SYSTEM

1. Write any four functions of blood.

_____

_____

_____

_____

2. Name the following.

a. The circulation of blood between the lungs and the heart: _____

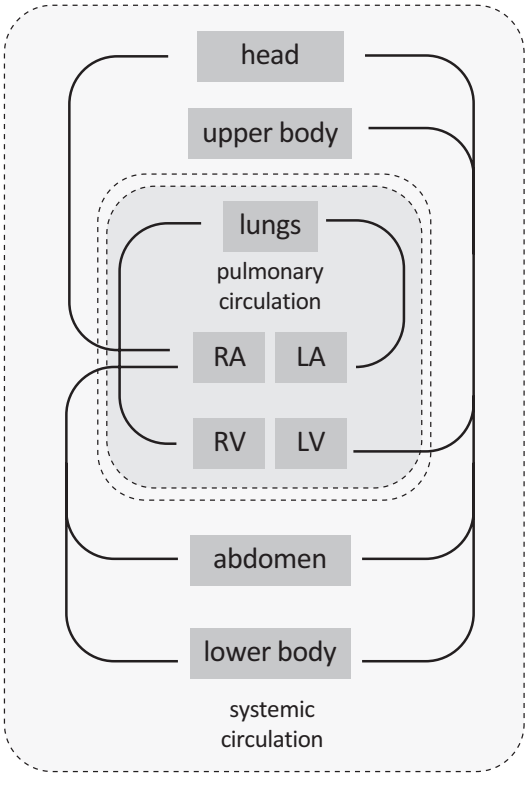
b. The arteries that carry deoxygenated blood from the right ventricle to the lungs: _____

c. The blood vessel that brings deoxygenated blood from the lower body: _____

d. The heart is made of this muscle: _____

e. The chamber in the heart that gets deoxygenated blood from all parts of the body: _____

3. The diagram given shows circulation of blood in the body. Draw arrowheads to show flow of blood in the human body.

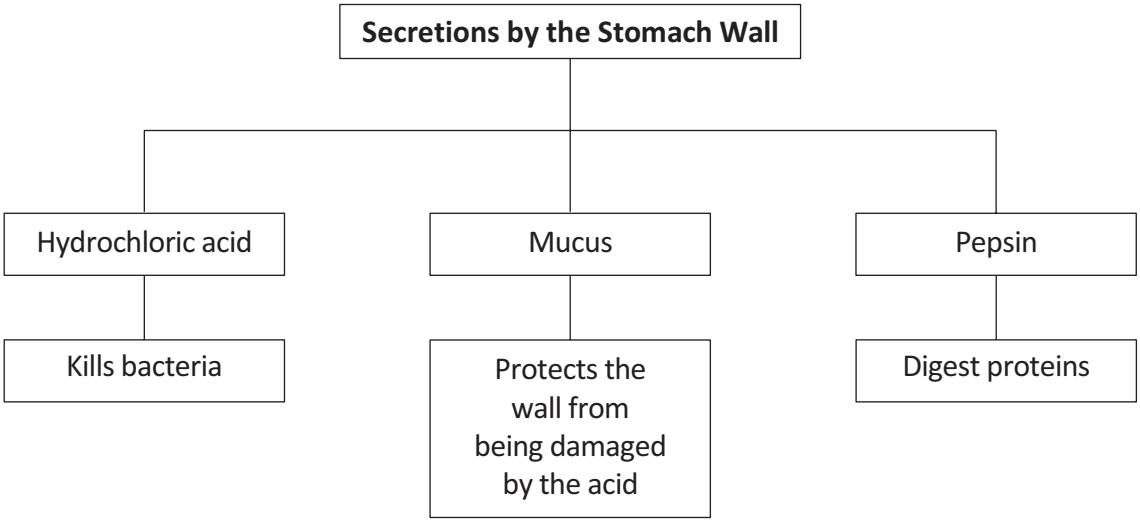


ANSWER KEY FOR THE WORKSHEET

THE DIGESTIVE SYSTEM

1. e, a, d, b, c

2.



3. a. Oesophagus b. Large intestine c. Stomach d. Mouth
e. Anus

ANSWER KEY FOR THE WORKSHEET

THE RESPIRATORY SYSTEM

1. A: Ribs B: Diaphragm

a. A: the ribcage moves upwards and outwards; B: the diaphragm contracts and moves down

2. c, b, a

3. a. aerobic respiration b. haemoglobin c. cartilage

4. a. Oxygen diffuses into the capillaries around the alveoli; oxygen is used by cells during cellular respiration

b. Carbon dioxide diffuses from the blood into the alveoli; carbon dioxide is released in the cells during respiration.

c. Water vapour is added to the air in the lungs.

ANSWER KEY FOR THE WORKSHEET

THE CIRCULATORY SYSTEM

1. Blood has the following main functions:

- It transports oxygen from the lungs to all the cells in the body, and carbon dioxide from every cell in the body to the lungs.
- It supplies nutrients to every part of the body.
- It helps to remove waste products from every cell in the body.
- White blood cells help to fight infections.
- It helps in the formation of blood clots, thus preventing further loss of blood.
- It helps to regulate the temperature of the body. (*any four*)

2. a. pulmonary circulation b. pulmonary arteries
c. inferior vena cava d. cardiac muscle e. right auricle

3. Diagram: Refer to the coursebook.