Activity 7.3 To study the process of yeast fermentation

Experiment

Problem statement
What are the products of yeast fermentation?

Hypothesis
Yeast fermentation produces energy, carbon dioxide and ethanol.

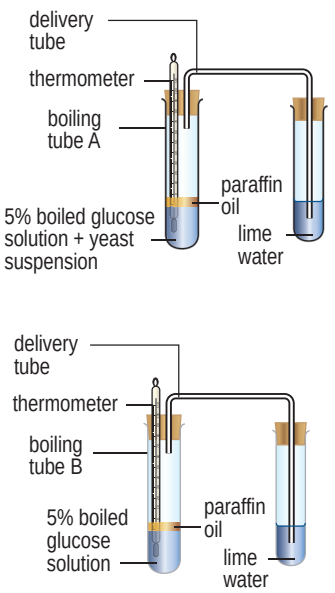
Variables
Manipulated: Presence of yeast
Responding: Changes in temperature, lime water and ethanol smell
Fixed: The volume of boiled glucose solution and the anaerobic condition

Take Note!
Ensure that the end of the delivery tube is soaked in lime water.

Materials
5% yeast suspension, 5% boiled glucose solution, lime water and paraffin oil

Apparatus
Boiling tube, test tube, thermometer, measuring cylinder, delivery tube and cork

Procedure
1. Fill 2 boiling tubes with 15 ml of 5% glucose solution that has been boiled and left to cool.
2. Label the boiling tubes as A and B.
3. Put 5 ml 5% yeast suspension into boiling tube A.
4. Add paraffin oil into both of the boiling tubes.
5. Close both boiling tubes with the cork that has a hole and a delivery tube. Prepare 2 test tubes with 2 ml of lime water respectively. Dip the end of each delivery tube into each test tube that contains lime water.
6. Leave the apparatus for 1 hour.
7. Measure and record the initial and final temperature using a thermometer.
8. Record your observations in the table below.



Apparatus set-up to study the yeast fermentation process

Results

Boiling tube	Temperature (°C)		Change in lime water	Smell of solution
	Beginning of experiment	End of experiment		
A				
B				

Discussion
1. How is the anaerobic condition maintained to ensure that the fermentation process is complete?
2. What is the function of preparing boiling tube B?

3 What is the purpose of boiling the glucose solution earlier?

4 How do the results show that fermentation has taken place in boiling tube A?

Conclusion

Is the hypothesis accepted? Suggest a suitable conclusion.

Comparison between aerobic respiration and fermentation

There are a few similarities and differences between fermentation and aerobic respiration (Figure 7.2 and Table 7.1).

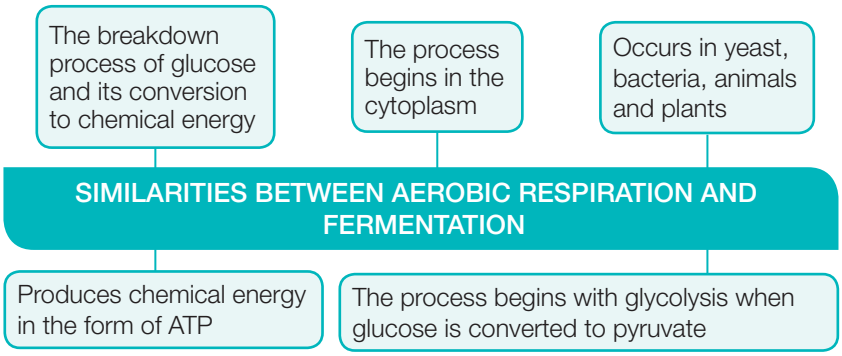


FIGURE 7.2 Similarities between aerobic respiration and fermentation

Brainstorm!

Why is aerobic respiration more suitable for yeast compared with fermentation?

TABLE 7.1 Differences between aerobic respiration and fermentation

DIFFERENCES	
Aerobic Respiration	**Fermentation**
The breakdown process of glucose is completed in the presence of oxygen.	The breakdown process of glucose is incomplete without oxygen or in limited oxygen conditions.
Occurs in cytoplasm and mitochondrion.	Occurs in cytoplasm.
Produces water.	Does not produce water.
Glucose is oxidised completely into carbon dioxide and water.	Glucose is not oxidised completely into ethanol and carbon dioxide or lactic acid.
One molecule of glucose generates 2898 kJ of energy	One molecule of glucose generates 210 kJ (alcoholic fermentation) or 150 kJ (lactic acid fermentation) of energy

Formative Practice 7.3

1 State where the process of fermentation usually occurs.

2 Give three examples of microorganisms and food produced by the fermentation process.

3 While helping your father to cut the grass at the farm, you come across a snake. Terrified, you run away from the snake. Explain the cellular respiration that takes place in the muscle cells of your legs.

4 State the differences between aerobic respiration and fermentation.

Summary

CELLULAR RESPIRATION

Production of energy through cellular respiration

The main substrate in energy production is glucose

Aerobic Respiration

The breakdown of glucose in the presence of oxygen to produce chemical energy

Occurs in cytoplasm
Glucose → Pyruvate

Occurs in mitochondrion (pyruvate oxidation)
Carbon dioxide + water + energy

Anaerobic Respiration

The incomplete breakdown of glucose in limited oxygen or no oxygen

Fermentation

- Alcohol fermentation
- Lactic acid fermentation

Self Reflection

Have you mastered the following important concepts?

- The necessity of energy in metabolic processes
- The main substrate in the production of energy
- Types of cellular respiration
- Energy production from glucose during aerobic respiration in cells
- Word equation for aerobic respiration in cells
- Factors that cause fermentation to occur in cells
- Example of energy production from glucose during fermentation
- Lactic acid fermentation and alcohol fermentation
- Yeast fermentation process
- Differences between aerobic respiration and fermentation

Summative Practice 7

1 What are the uses of alcohol fermentation products?

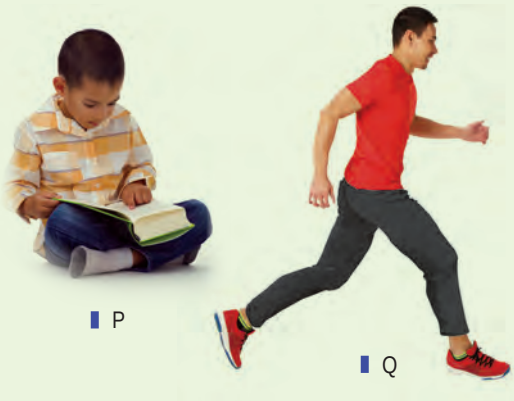
2 Why do muscles carry out cellular respiration that produces lactic acid during vigorous training?

3 Why does cellular respiration in muscles that produce lactic acid supply less energy compared to aerobic respiration?

4 Explain why an individual usually feels tired faster compared with an athlete, when both of them are running together.

5 A 100-metre sprinter usually holds his breath while running compared with a long-distance runner. After running, the sprinter needs seven litres of oxygen to remove the lactic acid in his muscle cells. Explain this difference between the sprinter and the long-distance runner.

6 Photograph 1 shows the activities by two individuals, P and Q.



PHOTOGRAPH 1

(a) (i) Based on Photograph 1, identify the respiration that occurs in the muscles of individuals P and Q.
(ii) State the products of respiration in P and Q.

(b) During the 100-metre sprint on Sports Day, a pupil experienced muscle cramps and had to stop running. Explain why muscle cramps happen.

(c) Paddy plants grown in waterlogged areas have tolerance to ethanol compared with other plants.
(i) State the type of fermentation that occurs in paddy plant cells.
(ii) Write the word equation for the fermentation process that occurs in the paddy plant cells.
(iii) Suggest another cell that can carry out the fermentation process as in question c(ii).

Essay Questions

7 (a) Explain why energy is required in metabolic processes.

(b) Compare aerobic respiration with fermentation.

(c) Microorganisms such as yeast and bacteria usually play an important role in the fermentation process to produce food. Explain why yoghurt can spoil if it is not kept in the refrigerator.

Enrichment

8 A person who is not used to exercising will experience muscle cramps when doing vigorous exercise because of the accumulation of lactic acid in the cells. However, for high-performance athletes, such problems do not occur because their bodies have a high tolerance for lactic acid. In your opinion, how do high performance athletes overcome the problem of lactic acid accumulation? Give your reasoning.

9 Studies have shown that intake of sodium bicarbonate or baking powder (*baking soda*) can increase muscle efficiency during intense activities that involve muscle fermentation. Give your justification.

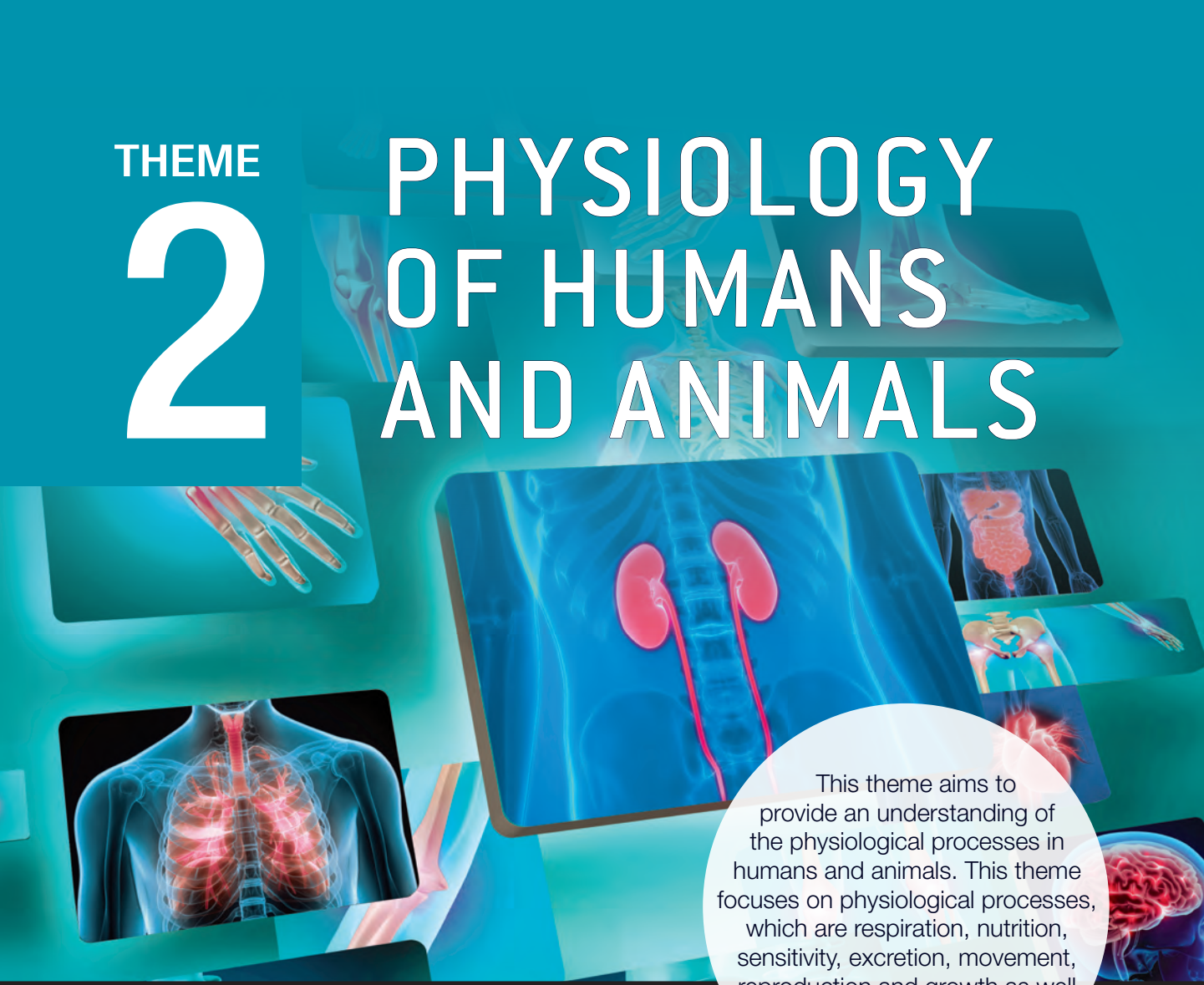
10 While conducting an experiment using yeast, Mei Ling found that if grape juice is kept with yeast in a covered container, the yeast will slowly break down the glucose in the grapes. However if the container does not contain any oxygen, the yeast will break down the glucose at a faster rate, and the alcohol content in the container will rise very fast. At the end of the experiment, Mei Ling found that the breakdown rate of glucose becomes slow again even though there are some grapes that have not been oxidised. Explain Mei Ling's observation.

11 Susan tried to make bread using dry yeast bought from a shop. When she mixed the yeast with plain flour, she found that her bread did not rise after half an hour. Explain how you can help Susan solve her problem.

Complete answers are available by scanning the QR code provided

THEME

2 PHYSIOLOGY OF HUMANS AND ANIMALS



This theme aims to provide an understanding of the physiological processes in humans and animals. This theme focuses on physiological processes, which are respiration, nutrition, sensitivity, excretion, movement, reproduction and growth as well as cell division.

CHAPTER

8 Respiratory Systems in Humans and Animals

Why is the respiratory system important to humans and animals?

Do You KNOW...

- What are the different respiratory structures found in:
  - insects
  - amphibians
  - fish
  - humans
- What are the adaptations of respiratory structures and their functions in gaseous exchange?
- What are the breathing mechanisms found in humans and animals?
- How does gaseous exchange between lungs and blood, and between blood and tissues occur?
- How does the transport of respiratory gases from lungs to tissues and from tissues to lungs occur?
- What are the health issues related to the human respiratory system?

8.1 Types of Respiratory System

8.1.1 Identify respiratory structures in:
- insects
- fish
- amphibians
- humans

8.1.2 Describe the adaptation of respiratory structures and their functions for gaseous exchange in:
- animals
- humans

8.1.3 Compare and contrast respiratory structures in humans and animals.

8.2 Mechanisms of Breathing

8.2.1 Compare and contrast breathing mechanisms in humans and animals.

8.3 Gaseous Exchange in Humans

8.3.1 Communicate about external and internal respiration:
- gaseous exchange between lungs and blood
- transport of respiratory gases from lungs to tissues
- gaseous exchange between blood and tissues
- transport of respiratory gases from tissues to lungs

8.4 Health Issues Related to the Human Respiratory System

8.4.1 Narrate the effects of *Chronic Obstructive Pulmonary Disease* (COPD) on the human respiratory system:
- asthma
- chronic bronchitis
- emphysema

8.1 Types of Respiratory System

Respiratory structures and their adaptations for gaseous exchange

ICT 8.1

Activity: To study the respiratory structure in insects, frogs and rats

You have learned about respiratory organs and systems in humans and animals in Form 3. **The respiratory structure** is the **respiratory surface** that enables gaseous exchange to occur between respiring organism cells and their outer environment. You have also learned in Theme 1, that unicellular organisms such as *Amoeba* sp. do not need a special respiratory structure because it has a large total surface area to volume ratio for gaseous exchange through **diffusion**.

The ratio of total surface area to volume (TSA/V) depends on the size of the organism. The bigger the size of the organism, the smaller the ratio of total surface area to volume. This means that for large and complex organisms, the volume of the body that requires oxygen will increase more than its total surface area. This explains why large and complex organisms cannot maintain gaseous exchange by diffusion through body surface only. Large organisms require a special respiratory structure for the efficient exchange of gases.

How are the respiratory structures of large-sized organisms adapted for efficient exchange of gases?

Activity Zone

Study the effects of an increase in total surface area on diffusion as an analogy in gaseous exchange.

Adaptations of respiratory structures for efficient exchange of gases in big organisms

- **Large ratio of total surface area to volume (TSA/V)** for the efficient exchange of respiratory gases.
- A **thin** respiratory structure that is one cell thick, allows the diffusion of respiratory gases to occur.
- The surface of the respiratory structure is always **moist** for respiratory gases to dissolve in them.
- The respiratory structure is complete with a **network of blood capillaries** (except for insects), that allows for the efficient delivery of respiratory gases.

8.1.1 8.1.2

The insect respiratory structure and its adaptations

The breathing system of insects is the **tracheal system** (Figure 8.1).

- There are small pores in the thorax and abdomen of insects called **spiracles**. The spiracle allows the intake of air into the air tube system, which is the **tracheal system**.
- The trachea branches out to form finer tubes called the **tracheole**. Tracheole is the respiratory surface. The tracheole has the following characteristics that allow for efficient respiratory gaseous exchange.
  - **A large number of tracheoles** provides a large total surface area for the exchange of gases.
  - The tracheole wall is **thin** and **moist**. This allows oxygen gas to diffuse into the cells while carbon dioxide quickly diffuses out of the cells into the tracheole.
- Some insects have **air sacs** in their trachea system. This sac is filled with air to speed up the delivery of respiratory gas during active body movements.

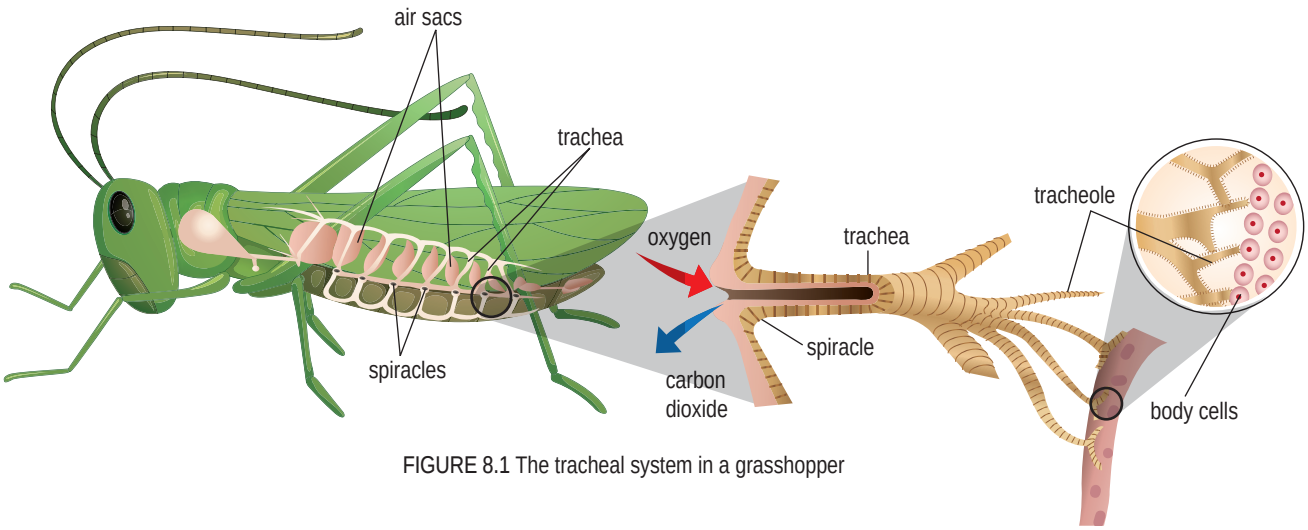


FIGURE 8.1 The tracheal system in a grasshopper

The fish respiratory structure and its adaptations

The respiratory structure of fish is the **gills** (Figure 8.2). The gills are made up of a line of **filament** that is supported by the **gill arch**. The following characteristics of filament enable the rapid exchange of respiratory gases.

- The filament has many **thin** and **flat** projections called **lamella** (plural: **lamellae**). A large number of filaments and lamellae gives a large total surface area for an efficient gaseous exchange process.
- The lamella membrane is **thin** and supplied with **many blood capillaries** for easy absorption and transport of oxygen and carbon dioxide.

Brainstorm!

Why can't fish gills function if the fish is not in the water?

8.1.1 8.1.2

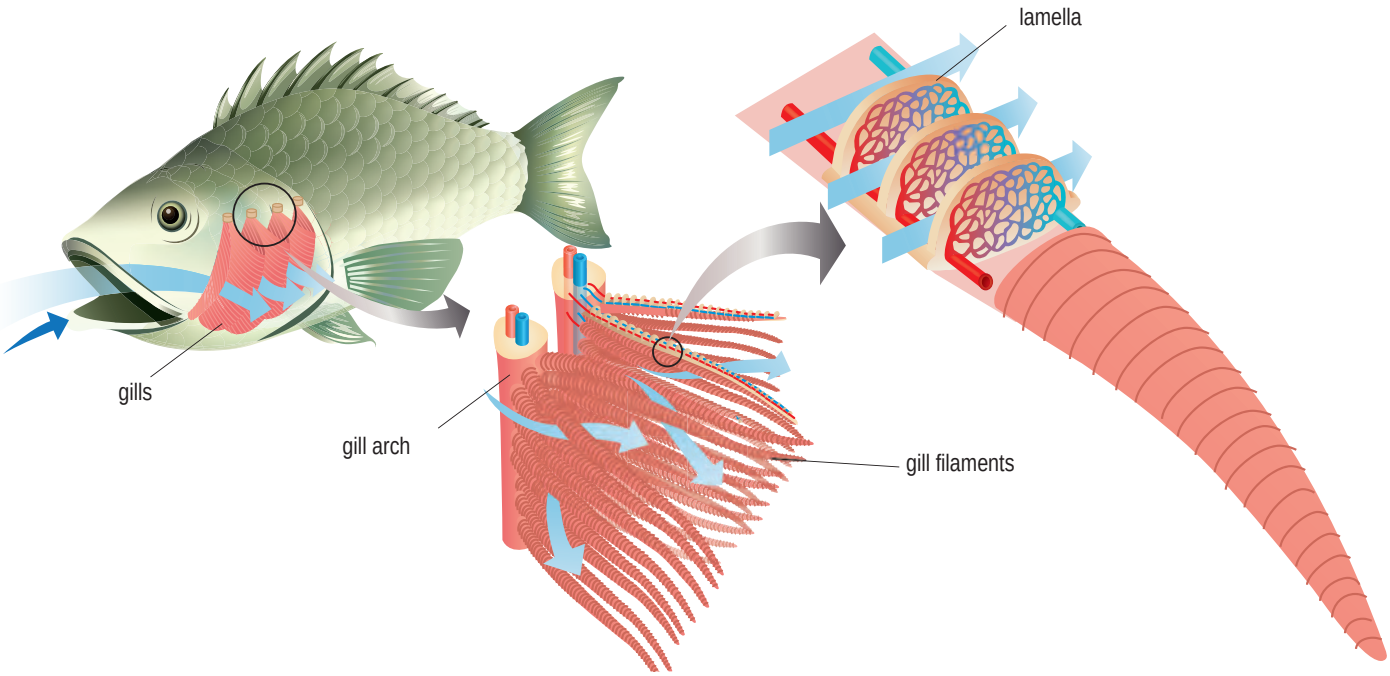


FIGURE 8.2 Respiratory structure of a fish

The frog respiratory structure and its adaptations

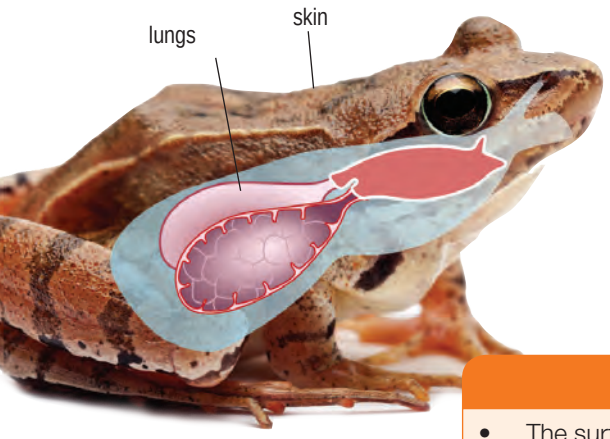


FIGURE 8.3 The respiratory structure of frogs

Skin

In an **inactive** state, the frog uses its **skin** for gaseous exchange (Figure 8.3).

- The skin is **thin** and highly **permeable** to respiratory gases.
- The **moist skin** allows respiratory gases to dissolve in it.
- Beneath the skin, there are many networks of **blood capillaries** to transport respiratory gases.

Lungs

- The surface of the lungs is **folded** to increase the total surface area for the exchange of gases (Figure 8.3).
- The **thin** lung membrane eases the diffusion of respiratory gases.
- The **moist** lung walls enable respiratory gases to dissolve in them.
- The lungs are also rich with **a network of blood capillaries** to transport respiratory gases.

8.1.1 8.1.2

The human respiratory structure and its adaptations

The human respiratory structure is the **alveolus** which has the characteristics for efficient respiratory gaseous exchange (Figure 8.4):

- A large number of alveoli provides **a large total surface area** for the diffusion of respiratory gases.
- The alveolus wall is always **moist**. Oxygen and carbon dioxide can dissolve easily, and diffuse through the walls into the blood capillaries.
- The alveolus is surrounded by a large **network of blood capillaries** to hasten the diffusion of respiratory gases.
- The thin alveolus wall, that is **as thick as one cell**, makes the diffusion of gases much easier.

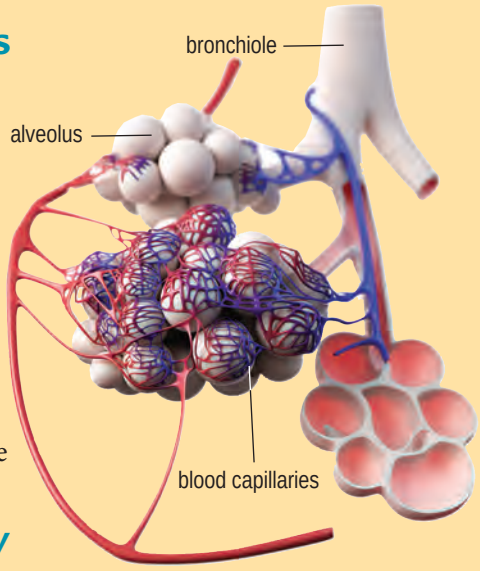


FIGURE 8.4 Alveolus

Comparison and contrast of respiratory structures in humans and animals

Table 8.1 shows the similarities and differences between the respiratory structures of humans and animals.

TABLE 8.1 Similarities and differences between the respiratory structures of humans and animals

Similarities
• All respiratory structures have a large ratio of total surface area to volume for an efficient exchange of respiratory gases. • All respiratory structures are thin and this makes the diffusion of respiratory gases much faster. • All respiratory structures are moist and this allows respiratory gases to dissolve in them. • The respiratory structure is complete with a network of blood capillaries (except insects), that allows for efficient transport of respiratory gases.

Differences				
Characteristics	Insects	Fish	Frogs	Humans
Respiratory structure	Tracheole	Filament and lamella	Skin and lungs	Alveolus
How the large ratio of total surface area to volume for the respiratory structure is achieved	Large number of tracheoles	Large number of filaments and lamellae	• The surface in the lungs is folded • Overall skin surface	Large number of alveoli

Formative Practice 8.1

1 State the adaptations of the human respiratory structure.

2 Explain how the frog skin is adapted for efficient exchange of gases.

3 State the characteristics of tracheoles that help with gaseous exchange in insects.

4 Predict what will happen to a fish if its gills are torn after being caught in a net.

8.1.1 8.1.2 8.1.3

8.2 Mechanisms of Breathing

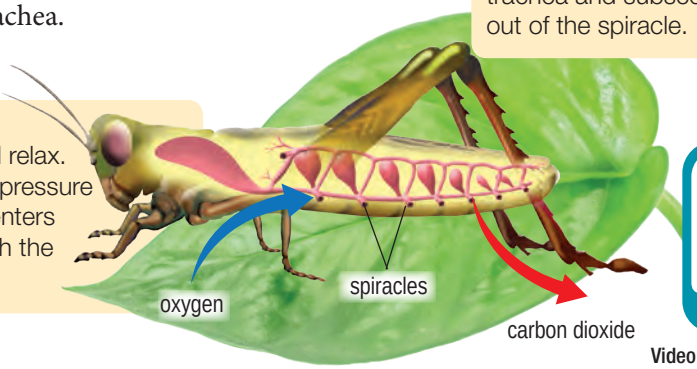
Humans and animals have different breathing mechanisms. **Breathing** refers to the repetitive inhalation and exhalation process.

Breathing mechanism of insects

Abdominal muscles that relax and contract enables air to go in and out of the trachea.

The abdominal muscles will contract when air is exhaled. This will increase the air pressure in the trachea and subsequently forces air out of the spiracle.

When inhaling air, the abdominal muscles will relax. This will reduce the air pressure in the trachea and air enters into the trachea through the spiracle.

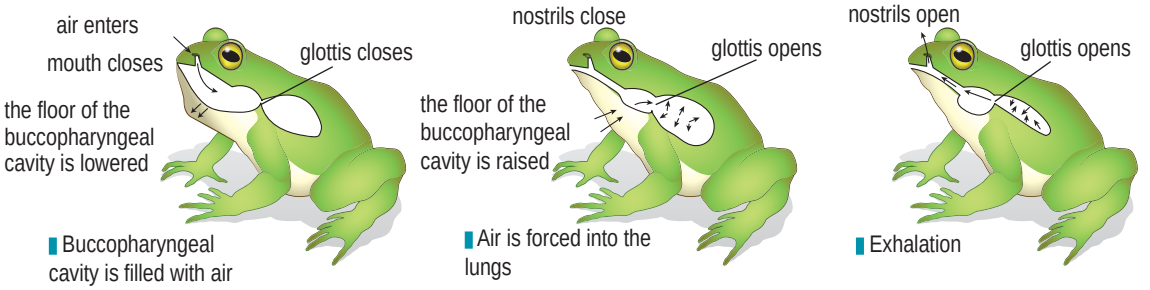


ICT 8.2

Video: Breathing mechanism of insects (Accessed on 21 August 2019)

Breathing mechanism of frogs

Frogs breathe through the mouth and lungs while in an active state. The sequence of inhalation and exhalation is summarised below.



Inhalation

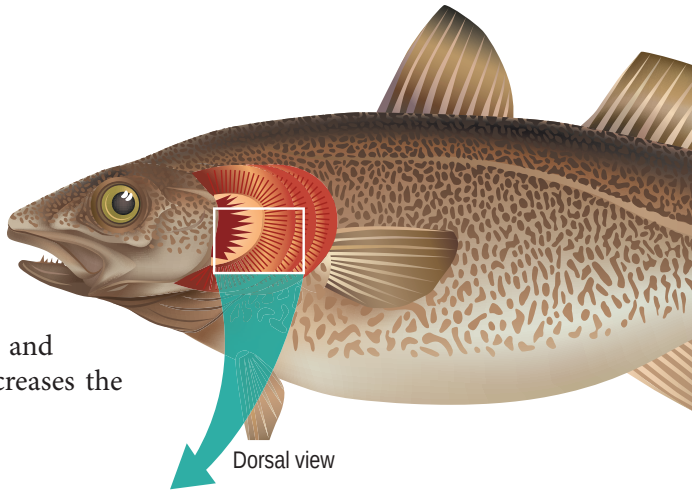
- When the frog breathes through the nostrils, the mouth and glottis are closed and the floor of the buccopharyngeal cavity is lowered.
- The low air pressure in the mouth cavity draws air into the buccopharyngeal cavity through the nostrils.
- When the glottis opens, the nostrils close and the floor of the buccopharyngeal cavity is raised.
- The increased air pressure pushes air into the lungs.

Exhalation

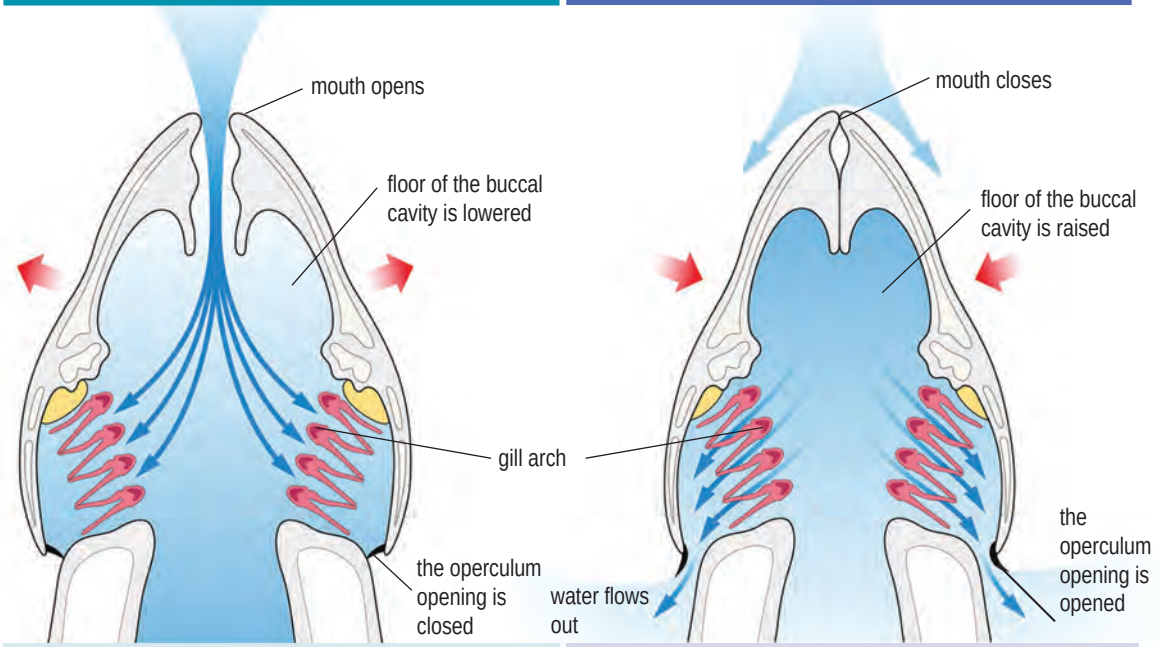
- When the lungs contract, air is expelled from the lungs.
- This is helped by the abdominal pressure and the elasticity of the lungs.
- Some air is expelled through the nostrils while the rest is mixed with the air in the buccopharyngeal cavity.

Breathing mechanism of fish

The breathing mechanism of fish is aided by its mouth movement and operculum. Ventilation takes place when the fish swims by opening and closing its operculum. This pushes water into the mouth and subsequently through the gills. The ventilation increases the flow of water in the respiratory surface.



INHALATION	EXHALATION



- When the mouth opens, the floor of the buccal cavity is lowered.
- At the same time, the opercular cavity is enlarged and the operculum opening is closed.
- This reduces the pressure in the buccal cavity.
- Water from the outside which contains dissolved oxygen enters the mouth.

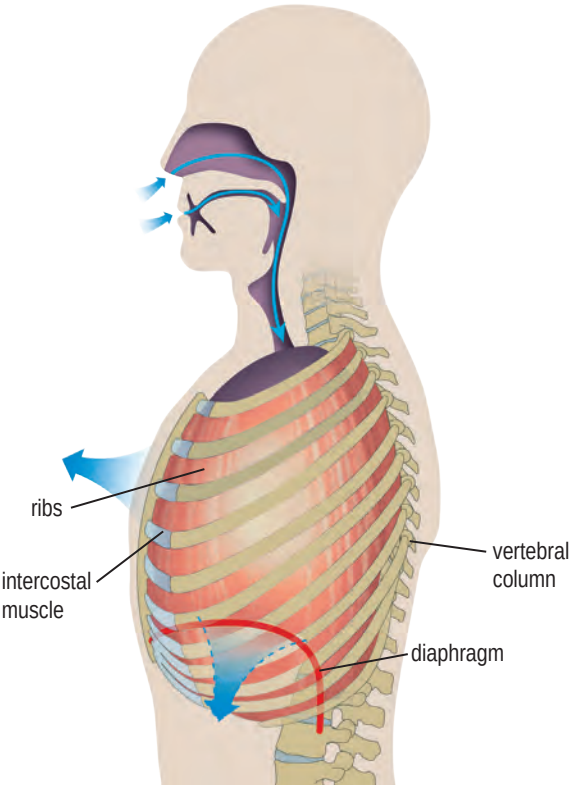
- When the mouth is closed, the floor of the buccal cavity is raised.
- Water enters through the gill lamella and gaseous exchange between blood and water occurs through diffusion.
- At the same time, the operculum muscle relaxes and the opercular cavity becomes smaller.
- The volume of the buccal cavity is reduced and the pressure in the buccal cavity becomes higher than the pressure outside.
- The high pressure causes water to flow through the operculum opening.

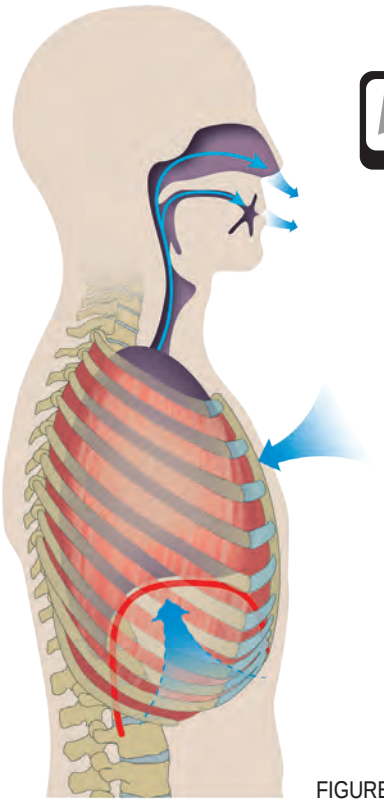
Breathing mechanism of humans

The inhalation and exhalation mechanisms of humans are shown in Figure 8.5.

INHALATION

1. The external intercostal muscles contract while the internal intercostal muscles relax.
2. This action causes the ribcage to move upwards and outwards.
3. At the same time, the diaphragm muscles contract and the diaphragm moves downwards to become flat and horizontal.
4. Both mechanisms cause the volume of the thorax cavity to increase and the pressure of the thorax cavity decreases.
5. The higher atmospheric pressure from outside forces air into the lungs.





AR

EXHALATION

1. The external intercostal muscles relax while the internal intercostal muscles contract.
2. This action causes the ribcage to move downwards and inwards.
3. At the same time, the diaphragm muscles relax and the diaphragm curves upwards to form a dome.
4. Both movements cause the volume of the thoracic cavity to reduce and the pressure of the thorax cavity to increase.
5. Air is pushed out of the lungs.

FIGURE 8.5 The inhalation and exhalation mechanisms of humans

Compare and contrast breathing mechanisms in humans and animals

What are the similarities and the differences between breathing mechanisms in humans and animals? Table 8.2 explains the comparison between the breathing mechanisms in humans and animals.

TABLE 8.2 Comparison between breathing mechanisms in humans and animals

Similarities
• Humans and animals have special muscular structures to expand and contract the respiratory cavity. • The breathing mechanism involves changes in the volume and pressure in the respiratory cavity.

Differences between breathing mechanisms of insects, fish, frogs and humans				
Characteristics	Insects	Fish	Frogs	Humans
Respiratory aperture	Spiracle	Mouth and operculum	Nostrils	Nostrils
Structure that helps breathing	Thorax, abdomen	Operculum and muscular floor of buccal cavity	Muscular buccopharyngeal wall	Diaphragm, ribcage and intercostal muscles
Breathing mechanism	Assisted by the contraction and relaxation of abdominal muscles	Assisted by movements of the floor of the buccal cavity and operculum	Assisted by the rapid movement of the buccopharyngeal cavity floor and elasticity of the lungs	Assisted by the contraction and relaxation of the intercostal muscles and the diaphragm muscles as well as the movement of the rib cage upward and outward, and downward and inward

CHAPTER 8

Formative Practice 8.2

1 State the function of the spiracle in the breathing mechanism of insects.

2 How do abdominal muscles help insects to breathe?

3 State the two differences between the respiratory mechanisms of fish and humans.

4 Explain the mechanism of inhalation in humans.

Activity Zone

Construct a model to show the actions of diaphragm muscles during breathing in humans.

8.2.1

8.3 Gaseous Exchange in Humans

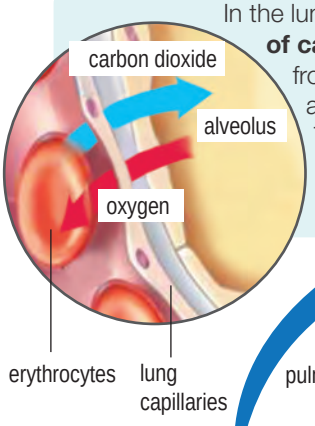
Partial pressure of oxygen and carbon dioxide

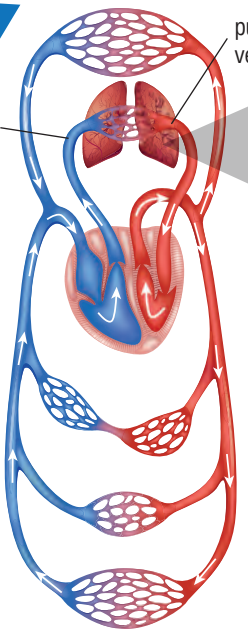
Gas diffusion depends on the partial pressure difference between two areas. The gas diffuses from an area where its partial pressure is higher to an area where its partial pressure is lower, which is down a partial pressure gradient.

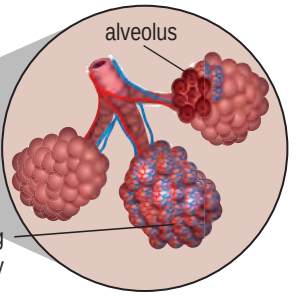
Gaseous exchange and the transport of respiratory gases

In the lungs, blood that enters the lung capillaries contains a higher **partial pressure of carbon dioxide** compared to the alveolus. Carbon dioxide diffuses out from the lung capillaries and into the alveolus before it is expelled into the atmosphere through the nose and mouth.

The **partial pressure of oxygen** in the alveolus is higher than the lung capillaries. Oxygen diffuses into the lung capillaries. Oxygen combines with haemoglobin in erythrocytes to form oxyhaemoglobin.







Blood that enters the lungs through the **pulmonary artery** has a low partial pressure of oxygen and a high partial pressure of carbon dioxide.

Blood that leaves the lungs through the **pulmonary vein** has a high partial pressure of oxygen and a low partial pressure of carbon dioxide.

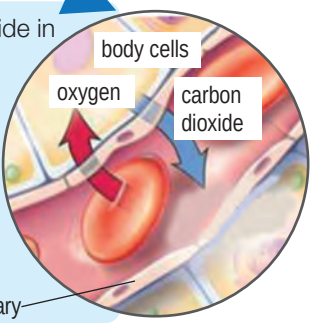
FIGURE 8.6 Gaseous exchange and the transport of respiratory gases in blood circulation

Cellular respiration releases carbon dioxide. The partial pressure of carbon dioxide in cells is higher than tissue capillaries.

Carbon dioxide diffuses out from the body cells into the tissue capillaries and is transported back to the lungs.

When blood reaches the tissue through the tissue capillaries, the partial pressure of oxygen in the blood is higher than that of body cells because cellular respiration uses oxygen.

Oxyhaemoglobin breaks down and oxygen diffuses from the tissue capillaries to the body cells.



Transport of carbon dioxide in the blood circulatory system

Carbon dioxide is transported in three ways:

- 70% is carried in the form of bicarbonate ion (HCO_3^-)
- 23% carbon dioxide combines with haemoglobin to form carbaminohaemoglobin
- 7% is dissolved and carried as carbonic acid (H_2CO_3)

The transport of carbon dioxide from body cells to tissue capillaries

- Carbon dioxide (CO_2) released by the body cells binds with water (H_2O) in the erythrocyte to form carbonic acid (H_2CO_3).
- The carbonic anhydrase enzyme in erythrocyte catalyses this reaction.
- Carbonic acid (H_2CO_3) will break down into bicarbonate ion (HCO_3^-) and hydrogen ion (H^+).
- Then HCO_3^- diffuses into the blood plasma and is carried to the lungs.

The transport of carbon dioxide from lung capillaries to the alveolus

- When the bicarbonate ion in blood plasma reaches the lung capillaries, it diffuses back into the erythrocyte.
- The bicarbonate ion combines again with a hydrogen ion (H^+) to form carbonic acid (H_2CO_3).
- Carbonic acid (H_2CO_3) then breaks down into carbon dioxide and water.
- Carbon dioxide diffuses through the lung capillaries into the alveolus and is expelled during exhalation.

Brainstorm!

Explain why the haemoglobin in foetus has a higher percentage of oxygen saturation compared to haemoglobin in adults.

Biological Lens

Atmospheric pressure at sea level is 760 mm Hg. As the atmosphere consists of 21% oxygen (as per volume), the partial pressure of oxygen is 0.21 x 760 mm Hg or 160 mm Hg. This means that the oxygen pressure in the atmospheric pressure is 160 mm Hg. The partial pressure of carbon dioxide at sea level is 0.23 mm Hg.

Formative Practice 8.3

1 What is the value of the partial pressure of oxygen in the atmospheric pressure?

2 In what form is carbon dioxide transported in human blood circulatory system?

3 Explain how carbon dioxide is transported from the lung capillaries to the alveolus.

4 In what form is oxygen carried to the tissues?

Brainstorm!

Explain why exposure to carbon monoxide for a very short period is more dangerous for an individual as compared to exposure to carbon dioxide.

8.4 Health Issues Related to the Human Respiratory System

Activity Zone

Discuss the causal factors and methods of treatment for asthma, chronic bronchitis and emphysema.

Chronic Obstructive Pulmonary Disease **(COPD)** comprises **asthma, chronic bronchitis** and **emphysema**. In **emphysema**, the alveolus loses its elasticity and increases in size. The alveolus wall is damaged, the total surface area of alveolus decreases and the gaseous exchange becomes less efficient.

In **chronic bronchitis**, the bronchiole becomes inflamed, swollen and blocked. This reduces the flow of air and causes difficulties in breathing. A large amount of mucus formed will cause continuous coughing. Damaged cilium causes difficulty in expelling mucus.

For an asthmatic patient, the bronchiole walls become swollen and thick. The opening of the bronchiole tube becomes smaller and the air passage becomes narrower. This condition leads to difficulties in breathing and causes breathlessness. Figure 8.7 shows the lungs of a COPD patient.

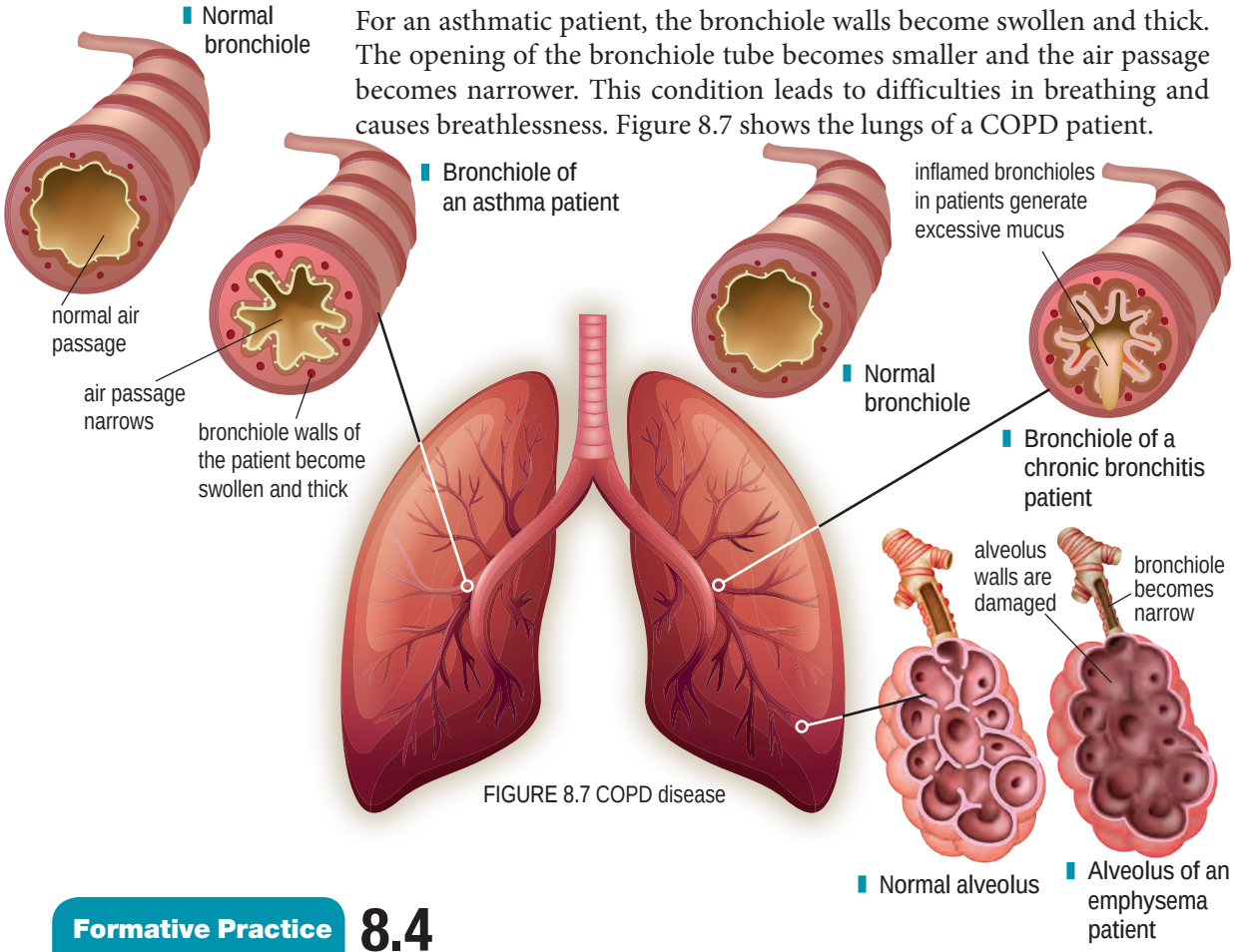


FIGURE 8.7 COPD disease

Formative Practice 8.4

1 What are the effects of chronic bronchitis on the bronchiole?

2 Explain the condition of bronchiole walls in asthmatic patients.

3 How does the usage of an inhaler help an asthmatic patient to breathe?

4 Explain why the gaseous exchange becomes less efficient for an emphysema patient.

Summary

RESPIRATORY SYSTEMS IN HUMANS AND ANIMALS

Types of Respiratory System

- Insects: tracheal system and tracheole
- Fish: gill
- Amphibian: lungs and moist skin
- Human: trachea, bronchus and alveolus

Mechanisms of Breathing

Breathing is the process of inhalation and exhalation

Gaseous Exchange in Humans

Subject to the partial pressure of carbon dioxide and oxygen

- Oxygen is transported in the form of oxyhaemoglobin
- Carbon dioxide is transported in the form of bicarbonate ion, carbaminohaemoglobin and carbonic acid

Health Issues Related to the Human Respiratory System

Chronic Obstructive Pulmonary Disease (COPD): asthma, chronic bronchitis and emphysema

Self Reflection

Have you mastered the following important concepts?

- The respiratory structure in animals and humans
- Respiratory structure adaptations and its function in the exchange of gases
- Respiratory structure of humans and animals
- Breathing mechanisms in humans and animals
- Gaseous exchange between lungs and blood and between blood and tissues
- Gaseous exchange from lungs to tissues and from tissues to lungs
- Health issues related to human respiration

Summative Practice 8

1 Explain why a transportation system is not required to transport respiratory gases in insects.

2 Why are the lungs of amphibians not as efficient as human lungs?

3 The diaphragm of an individual no longer functions normally due to an accident. Explain how this condition affects the breathing mechanism of the individual.

4 How does an increase in heartbeat rate during an emergency, help a person to face the emergency?

5 (a) A hardcore smoker can easily suffer from a prolonged cough. Explain how this condition affects the function of the respiratory system.
(b) Describe another illness that may be easily contracted by a hardcore smoker.
(c) Explain the effects of tar that is present in cigarette smoke on the smoker.

6 One of the effects of emphysema is the loss of elasticity in the alveolus. Explain the effect of this on gaseous exchange.

7 (a) Name structures P and Q that help humans and fish, respectively in gaseous exchange.

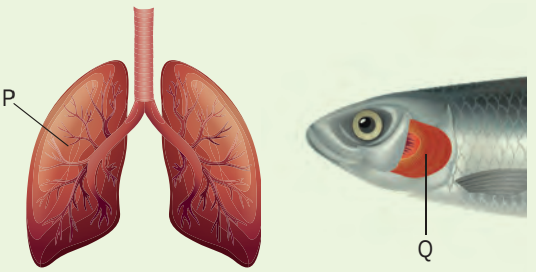


FIGURE 1

(b) Explain the breathing mechanism of fish.
(C) Describe two similarities of structure P and Q that has been adapted to help P and Q function effectively.
(d) Give two reasons why the rate of oxygen supply to human cells is faster than the rate of oxygen supply to fish cells if both are of the same size.

Essay Questions

8 The human respiratory systems of humans and grasshoppers have different adaptations to maximise the rate of gaseous exchange. State the similarities and differences between the human respiratory system and the grasshopper breathing system.

9 (a) Explain how air is inhaled into the lungs.
(b) Explain how a carbon dioxide molecule is carried from the body cell to the alveolus to be expelled.

Enrichment

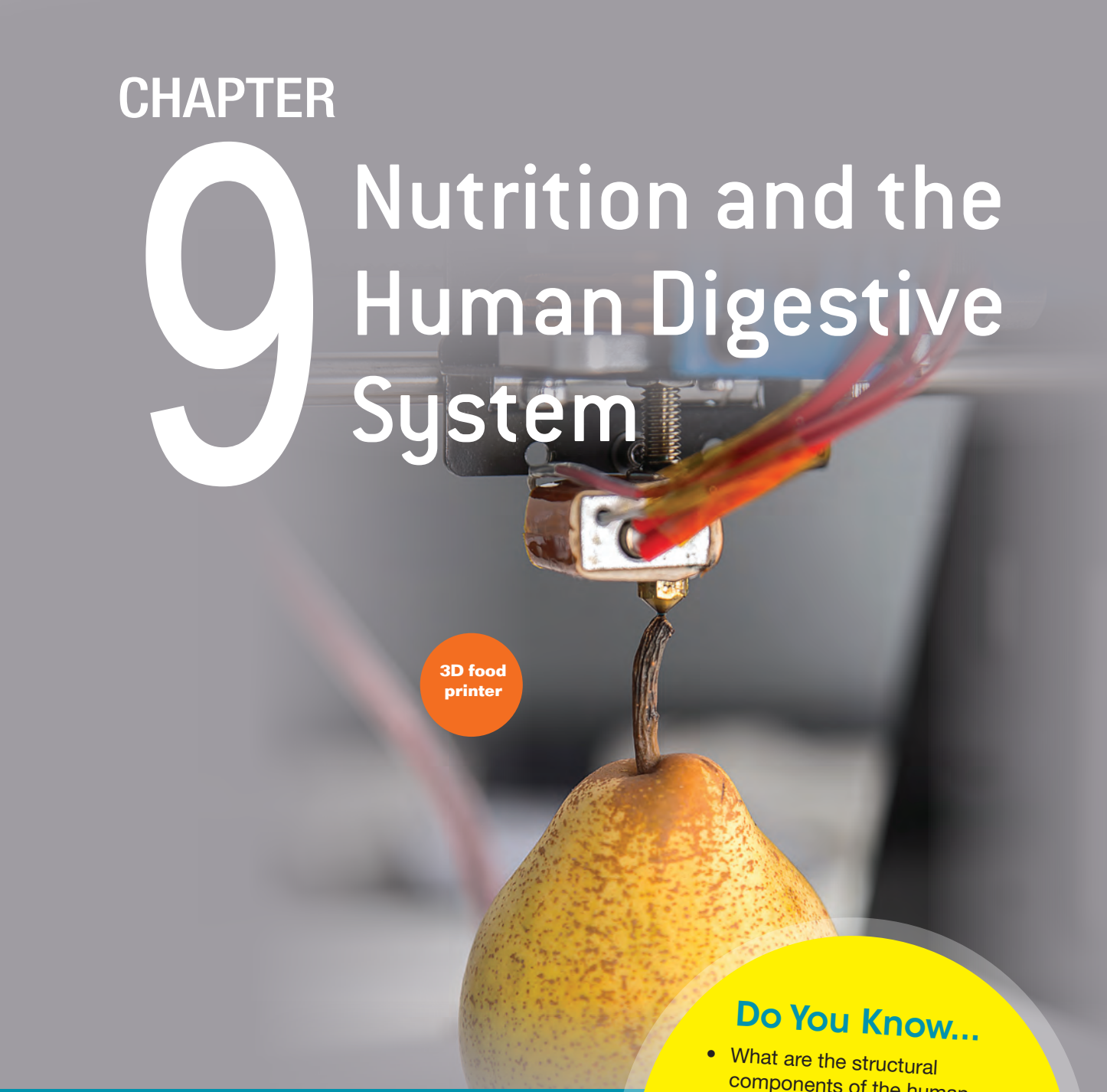
10 Air pollution makes breathing difficult in animals and humans. If you are a scientist, which animal will you choose as an indicator of pollution level in a particular area? Explain the justification of your choice.

11 All mammals breathe through the lungs, as with mammals that live in the sea such as whales. How does the whale breathe in water?

Complete answers are available by scanning the QR code provided

CHAPTER

9 Nutrition and the Human Digestive System



Can food be designed to meet the nutritional needs of humans?

Do You Know...

- What are the structural components of the human digestive system?
- How is food digested and absorbed?
- How does food assimilation occur?
- How does defaecation occur?
- What is a balanced diet?

9.1 Digestive System

9.1.1 Identify structures of the human digestive system.

9.2 Digestion

9.2.1 Describe the types of digestion:
- physical digestion
- chemical digestion

9.2.2 Analyse the process and products of carbohydrate digestion in the mouth.

9.2.3 Analyse the process and products of protein digestion in the stomach.

9.2.4 Describe digestions of carbohydrates, proteins and lipids in the small intestine.

9.2.5 Conduct experiments to study digestions of starch, proteins and lipids in food samples.

9.3 Absorption

9.3.1 Identify the structure of a villus in the ileum.

9.3.2 Communicate about the adaptations of ileum and villus in the absorption of digested food.

9.4 Assimilation

9.4.1 Describe the roles of the circulatory system in the assimilation of digested food.

9.4.2 Discuss the functions of liver in the assimilation of digested food:
- metabolism of digested food (carbohydrates and proteins)
- storage of nutrients
- detoxification

9.5 Defaecation

9.5.1 Explain the functions of the large intestine:
- absorption of water and vitamins
- formation of faeces

9.6 Balanced Diet

9.6.1 Conduct an experiment to study the energy values in food samples.

9.6.2 Conduct an experiment to determine the contents of vitamin C in fruit or vegetable juices.

9.6.3 Justify the modification of diets for individuals who:
- experience obesity
- experience a specific disease
  - diabetes mellitus
  - cardiovascular
  - cancer

9.7 Health Issues Related to Digestive System and Eating Habits

9.7.1 Predict the effects of modifying digestive organs on human health.

9.7.2 Outline health issues related to defaecation.

9.7.3 Correlate health issues that are related to eating habits.

9.1 Digestive System

Structure of the human digestive system

The human digestive system is made up of a long and muscular **alimentary canal** that starts from the mouth to the anus (Figure 9.1).

The parts of the alimentary canal include the mouth, oesophagus, stomach, small intestine, large intestine and anus. The other organs in the digestive system are liver, gallbladder and pancreas. **Salivary**, **gastric** and **intestinal glands** secrete digestive juices into the alimentary canal.

9.2 Digestion

Types of digestion

Digestion is the process that breaks down large and complex pieces of food into smaller and simple pieces that can be dissolved for easy absorption.

Digestion is made up of two parts, that is, **physical digestion** and **chemical digestion**.

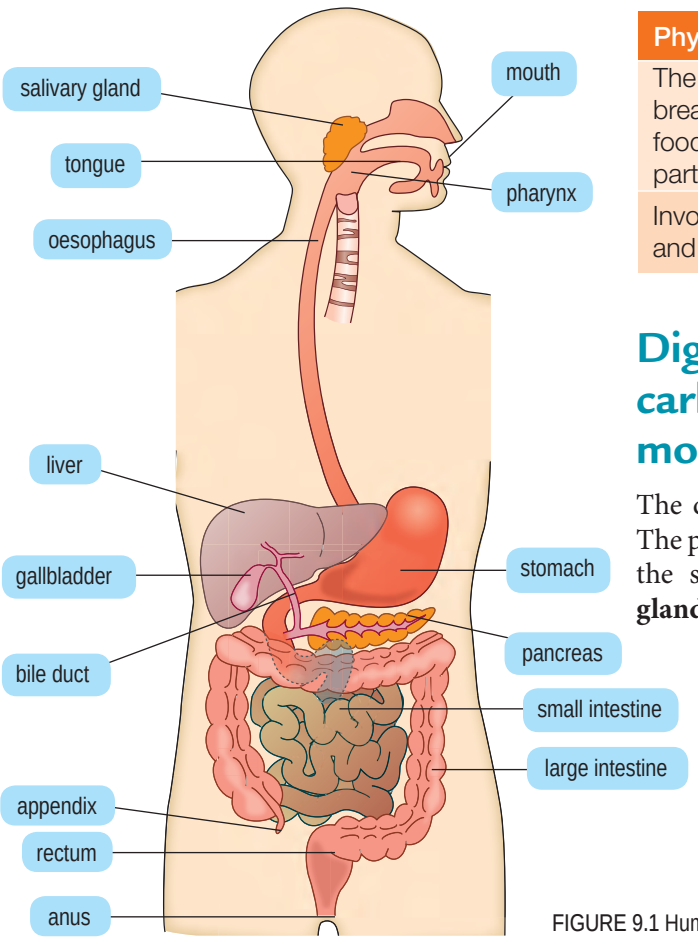


FIGURE 9.1 Human digestive system

Physical digestion	Chemical digestion
The mechanical breakdown of food to form small particles	The decomposition process of complex molecules into simple molecules
Involves chewing and peristalsis	Involves enzymes reaction

Digestion of carbohydrates in the mouth

The digestive process begins in the mouth. The presence of food in the mouth stimulates the secretion of saliva from the **salivary glands**.

AR

9.1.1 9.2.1 9.2.2