

Chapter 3

Nutrition

What kind of food gives us energy?

How do the energy needs of one individual differ from another individual?

What happens to the food that we eat?

Let's understand:

- Classes of food
- Importance of a balanced diet
- Human digestive system
- Process of absorption and transportation of digested food and defecation





SCIENCE BLOG

Astronaut Food

Malaysia's first astronaut, Dato' Dr. Sheikh Muszaphar Shukor was flown to the International Space Station (ISS) on 10th October 2007.

In relation to that, Malaysian Agricultural Research and Development Institute (MARDI) was tasked with carrying out a research about food for astronauts while they were in space.

According to the research carried out, the salt content in food decreases in space. Therefore, the research was done numerous times until it produced appetising, delicious and nutritious food in space.

Then, the food produced was sent to Russia to undergo various tests before getting approval. The food prepared was stored in air-tight plastic containers and was frozen to avoid spoilage.

Keywords

- ▶ Carbohydrate
- ▶ Protein
- ▶ Fat
- ▶ Vitamin
- ▶ Mineral
- ▶ Fibre
- ▶ Balanced diet
- ▶ Digestion
- ▶ Absorption
- ▶ Oesophagus
- ▶ Small intestine
- ▶ Large intestine
- ▶ Rectum
- ▶ Anus
- ▶ Defecation

What is your daily diet? Is it nutritious and energy-giving? Food not only supplies energy but also gives nutrients to maintain our health.



Nasi lemak



Satay

Photograph 3.1 Food is a basic need for humans

Our food is divided into seven main classes; **carbohydrate**, **protein**, **fat**, **vitamin**, **mineral**, **fibre** and **water** (Figure 3.1). Each food class has a specific function. Can you identify the food classes that are shown in each food item in Photograph 3.1?

Classes of food



Figure 3.1 Classes of food

Carbohydrate

Carbohydrate is an organic compound that contains **carbon**, **hydrogen** and **oxygen**. Carbohydrate is a staple for humans because it **supplies a lot of energy**. Examples of carbohydrate are **starch**, **glycogen** and **cellulose**. Starch is the food stored in plants, whereas glycogen is the **food stored** in animals. Cellulose is the carbohydrate that **forms the cell walls** of plants.



Some sources of carbohydrate, such as sugar supply energy quickly.



Banana



Rice



Bread



Potato



Honey



Sugar

Photograph 3.2 Sources of carbohydrate

Protein

Protein is a food substance that contains **carbon**, **hydrogen**, **oxygen** and **nitrogen**. Proteins we eat are digested to the basic unit, that is, **amino acid**. Protein is required for **growth** and to **repair damaged tissues** in the body as well as to **replace dead cells**. Apart from that, protein is also used to **synthesise enzymes**, **hormones** and **antibodies**. Photograph 3.3 shows a few sources of protein.

Science Info

Kwashiorkor is a kind of disease caused by protein deficiency in human diet and it generally occurs in children aged between 1 and 3 years.



Chicken

Seafood

Nuts

Meat

Egg

Milk helps me to grow because it is high in protein.

Photograph 3.3 Sources of protein

Fat

As in carbohydrate, **fat** contains **carbon, hydrogen** and **oxygen**. Fat is formed from **glycerol** and **fatty acid**.

Fat is a **high energy source** and **storage**. Each gramme of fat supplies two times the total energy supplied by carbohydrates. Fat **protects the organs** of the body such as the heart and kidneys. Apart from that, fat acts as a **transporter** for vitamin A, D, E and K. Excess fat in the body is stored under the skin as a **heat insulator** to regulate body temperature.



Fat from animals contains higher cholesterol than fat from plants.



Butter



Coconut oil



Palm oil



Groundnuts

Photograph 3.4 Sources of fat

Vitamin

Vitamin is an organic compound that does not supply energy, but is needed by the body in small quantities to **maintain good health**. Vitamins can be classified as **water-soluble vitamins** and **fat-soluble vitamins** (Figure 3.2). We obtain vitamins from vegetables, fruits, milk and meat. Table 3.1 shows the types, sources, importance and effects of vitamin deficiency.

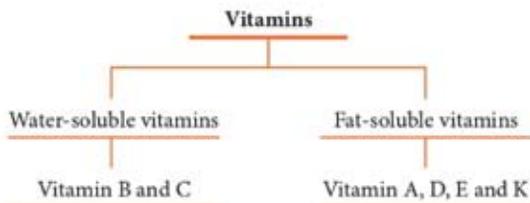


Figure 3.2 Classification of vitamins



Milk



Meat



Fruits



Vegetables

Photograph 3.5 Sources of vitamins

Table 3.1 Type, source, importance and effects of vitamin deficiency

Vitamin	Source	Importance	Effects of deficiency
A	milk, egg yolk, fish oil	<ul style="list-style-type: none"> Helps with night vision Maintains skin health 	<ul style="list-style-type: none"> night blindness skin diseases
B	yeast, liver, eggs	<ul style="list-style-type: none"> Maintains the functions of the nervous system Formation of red blood cells 	<ul style="list-style-type: none"> Beri-beri Anaemia
C	fruits, vegetables	<ul style="list-style-type: none"> Fights diseases Maintains the health of gums and mouth 	<ul style="list-style-type: none"> Scurvy (bleeding gums)
D	butter, eggs, fish oil, also produced through sun exposure	<ul style="list-style-type: none"> Helps in the absorption of calcium Strengthens tooth enamel Maintains skin health 	<ul style="list-style-type: none"> Rickets toothache skin diseases
E	grains, green vegetables	<ul style="list-style-type: none"> Maintains the functions of reproductive system 	<ul style="list-style-type: none"> sterility foetus miscarriage
K	milk, egg yolk, fish oil	<ul style="list-style-type: none"> Speeds up the blood-clotting process 	<ul style="list-style-type: none"> prolonged bleeding

Fibre

Fibre is a substance that cannot be broken down by the digestive system. Fibre comprises of **cellulose** that is found in the cell wall of plants.

Fibre is very important to **stimulate peristalsis**, that is, the movement caused by the constriction and relaxation of the muscles along the digestive tract such as oesophagus, small intestine and large intestine. This makes it easier for food to move along the digestive tract and prevents constipation.



High fibre bread

Fruits, vegetables and grains are high in fibre.



Vegetables



Grains



Photograph 3.6 Sources of fibre

Mineral

Mineral is a non-organic substance required by the body. Minerals do not supply energy, but are required in small quantities to regulate body processes to maintain health. Table 3.2 shows a variety of minerals, their importance and effects of deficiency.



Salt

Seafood

Photograph 3.7 Sources of mineral

Table 3.2 Types, sources, importance and effects of mineral deficiency

Mineral	Source	Importance	Effects of deficiency
Calcium	milk, anchovies, prawns, green vegetables	<ul style="list-style-type: none"> • Helps with blood-clotting • Strengthens bones and teeth 	<ul style="list-style-type: none"> • Rickets • Osteoporosis
Sodium	salt, meat, eggs	<ul style="list-style-type: none"> • Maintains the functions of the nervous system 	<ul style="list-style-type: none"> • muscle cramps
Iron	liver, meat	<ul style="list-style-type: none"> • Builds haemoglobin in the blood 	<ul style="list-style-type: none"> • Anaemia
Iodine	seafood, fruits	<ul style="list-style-type: none"> • Helps with the functions of thyroid gland 	<ul style="list-style-type: none"> • Goiter
Phosphorus	cheese, meat, eggs, vegetables	<ul style="list-style-type: none"> • Strengthens bones and teeth • Forms nucleic acid in DNA and RNA 	<ul style="list-style-type: none"> • Rickets • brittle teeth • cannot build DNA and RNA
Potassium	plants and animals	<ul style="list-style-type: none"> • Helps with muscle contraction • Maintains the functions of nervous system 	<ul style="list-style-type: none"> • paralysis • muscle cramps

Water

Water is a compound that is very important to our body. Water contains elements of **hydrogen** and **oxygen**. Water acts as a **chemical solvent** and a **transportation medium** of nutrients and oxygen into the cells. It transports waste materials such as urea and salt out of the cells and **regulates body temperature** through evaporation of sweat.

We need to drink at least 2 litres of water a day.



Fruit juice



Watermelon

Photograph 3.8 Sources of water



Activity 3.1

Aim: To test for the presence of starch, glucose, protein and fat.

Materials: Iodine solution, 1% starch suspension, Benedict's solution, 10% glucose solution, Millon's reagent, albumen suspension, ethanol, cooking oil and distilled water

Apparatus: Test tube, dropper, beaker, Bunsen burner, wire gauze, tripod stand, test tube holder, stopper and test tube rack

A Iodine test for starch

Instruction

1. Pour 2 ml of starch suspension into a test tube.
2. Add two drops of iodine solution into the test tube (Figure 3.3).
3. Record your observations.

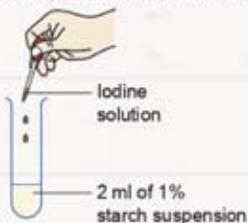


Figure 3.3

B Benedict's test for glucose

Instruction

1. Pour 2 ml of glucose solution into a test tube.
2. Add 2 ml of Benedict's solution into the test tube and shake it to mix the solutions.
3. Heat the test tube in a water bath for 5 minutes (Figure 3.4).
4. Record your observations.

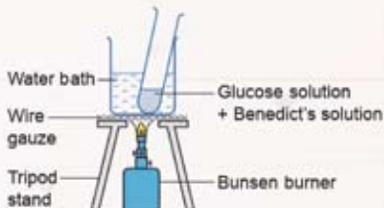


Figure 3.4

Science Info

Benedict's test is used to test the presence of reducing sugars. Examples of reducing sugars are glucose, maltose, galactose and fructose.

C Millon's test for protein

Instruction

1. Pour 5 ml of albumen suspension into a test tube.
2. Add two to three drops of Millon's reagent into the test tube (Figure 3.5 (a)). Then, shake the test tube to mix the solutions.
3. Heat the test tube in a water bath for 5 minutes (Figure 3.5 (b)).
4. Record your observations.

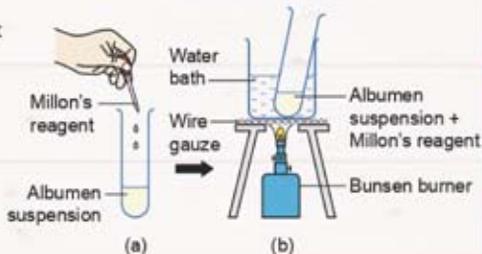


Figure 3.5

D Alcohol-emulsion test for fat

Instruction

1. Pour 3 ml of ethanol into a test tube.
2. Add 2 to 3 drops of cooking oil into the test tube (Figure 3.6 (a)). Then, close the test tube with a stopper.
3. Shake the test tube slowly and leave it in a test tube rack for 2 to 3 minutes.
4. Place 4 to 5 drops of the mixture from the test tube into another test tube filled with 20 ml of distilled water (Figure 3.6 (b)).
5. Close the test tube with the stopper and shake slowly. Leave the test tube in the test tube rack for 2 to 3 minutes.
6. Record your observations.

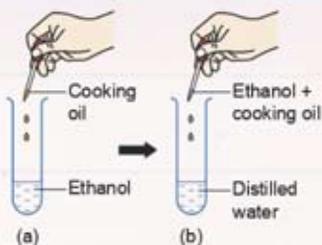


Figure 3.6

Safety Precaution

Ethanol is flammable.
Please keep it away from fire.

Observation

Activity	Observation
A	
B	
C	
D	

Questions

1. Why is the heating in the Benedict's test and Millon's test carried out in a water bath?
2. You are given a food sample in powder form. How do you determine the food class of the food sample? 🧠
3. What are the inferences you can make from each of the activity above?

Formative Practice 3.1

1. Name the food class based on the functions given.

Food class	Function
(a)	Regulates body temperature
(b)	Heals damaged body tissues
(c)	Required for energy
(d)	Protects from diseases

2. Name the diseases caused by deficiencies of the following vitamins.
(a) Vitamin A (c) Vitamin C
(b) Vitamin B (d) Vitamin D
3. State the effects to our health caused by deficiencies of the following minerals.
(a) Iodine (b) Iron (c) Phosphorus

3.2 Importance of a Balanced Diet

What is meant by a balanced diet?

A **balanced diet** is a diet that contains all the food classes in the right quantities that are required by the body.



i Science Info

The "Healthy Plate" model has been prepared by the Ministry of Health Malaysia as a guide to practise a balanced diet.



My Science World

Mother, how do I prepare a healthy meal?

We can refer to the food pyramid as a guide to prepare a healthy meal.



Limit the consumption of ultra-processed foods



Milk and milk products:
2 servings

Plain water: 6-8 glasses
1 glass = 250 ml

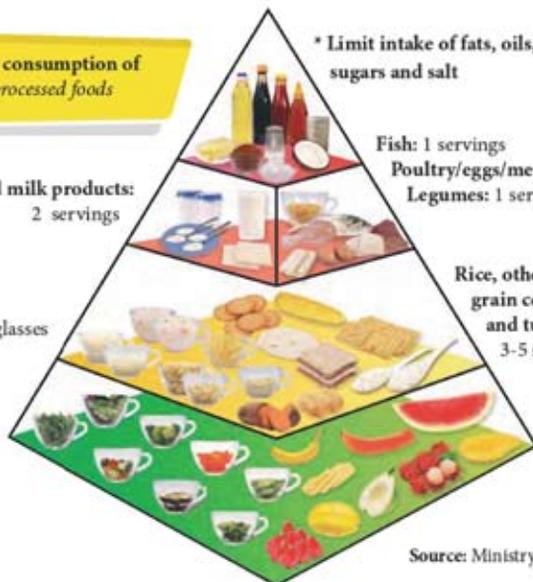
Vegetables:
≥ 3 servings

* Limit intake of fats, oils, sugars and salt

Fish: 1 servings
Poultry/eggs/meat: 1-2 servings
Legumes: 1 serving

Rice, other cereals, whole grain cereal-based products and tubers:
3-5 servings

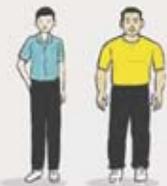
Fruits: 2 servings



Source: Ministry of Health Malaysia

Figure 3.7 Malaysian Food Pyramid 2020

Factors that Influence Calorific Requirement



Body size

A person with a large body frame needs to take a bigger portion of food because he or she needs to have more energy compared to someone with a smaller frame.

Age

Children and teenagers require more carbohydrates for energy and protein for growth because they are growing and are more active compared to adults.

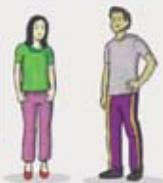


Work

Farmers, labourers and fishermen require more energy because they do heavy work. Therefore, their diet requirements are higher compared to people who work in an office.

Gender

Generally, men are more muscular and they do more heavy activities. Therefore, they need bigger food portions than women.



State of health

People who are sick are weak. They require food suitable to their health condition.

Climate

People who live in cold climate countries lose heat quickly to their surroundings compared to people who live in hot climate countries. Therefore, they need more food to maintain their body temperature.



Figure 3.8 Factors that influence a calorific requirement

Calorific Value of Food

Food contains some basic classes, such as **carbohydrate**, **protein** and **fat**. All of these basic classes produce different quantities of energy when burned. The total amount of energy released when 1 g of food is burned completely in the body is called **energy value** or **calorific value**. This total energy is measured in units of **calorie (cal)** or **joule (J)**.

Table 3.3 Energy value of fat, protein and carbohydrate

Food class	Energy value	
	(kJ / g)	(kcal / g)
Fat	37	9
Protein	17	4
Carbohydrate	17	4

1 calorie (cal) = 4.2 joule (J)
1 kilocalorie (kcal) = 4.2 kilojoule (kJ)

You have learnt about the calorific value of food. Can you estimate the calorific value of the food in your daily meals? Let's do Activity 3.2.



Activity 3.2

STEM

Aim: To estimate the calorific value of food.

Instruction

1. List the breakfast menu of your friends in class.

Example of a breakfast menu:



Fried rice



Banana



Milk

2. Estimate the calorific value for each of your classmates' menu items.

Example of the calculation:

Food	Quantity	Calorific value (kcal)
Fried rice	1 plate (330 g)	640
Banana	2 pieces (120 g)	$60 \times 2 = 120$
Milk	1 glass (250 ml)	130

The total calorific value for the breakfast consumed is 890 kcal

3. Find out whose breakfast has the highest and lowest calorific values.



A dietitian gives advice in terms of evaluating the status of an individual's diet before recommending a suitable diet.

How does the knowledge of calorific value of food help you choose food?



Let's carry out Activity 3.3.

Activity 3.3

Aim: To collect information on calorific value of food.

Instruction

1. Work in groups.
2. Each group is required to collect 2 food labels that show the food calorific value (Figure 3.9).



Figure 3.9

3. Fill in the calorific value of food found on the food labels in a table like the one below:

Food	Class of Food	Per 100 g	Calorific value (kJ)
Canned food	Carbohydrate		
	Protein		
	Fat		
	Carbohydrate		
	Protein		
	Fat		

4. Discuss the following things:
 - (a) which food has the lowest and highest calorific values?
 - (b) what other nutrients are printed on the food labels apart from carbohydrate, protein and fat?

Planning a Balanced Diet

Have you ever planned a balanced diet based on your calorie and nutrient requirements? As we have learnt, factors such as size of body frame, age, work, gender, health condition and climate influence the calorie and nutrient needs of a person.

Brain Teaser

If you are required to plan a menu for astronauts, what food would you recommend?

Why is planning a balanced diet important?



So that we remain active and healthy.



Activity 3.4

Aim: To plan a balanced meal for a day based on different factors.

Instruction

1. Work in groups.
2. Each group is required to prepare a menu for breakfast, lunch and dinner for one of the following individuals:
 - Individual A: a man who works as a bank officer
 - Individual B: a man who works as a construction worker
 - Individual C: a pregnant woman
 - Individual D: a school girl who is active in sports
3. Determine the quantity required for each food menu.
4. Total the calorific values consumed in one day.
5. Produce the planned menu according to your group's creativity.

Questions

1. What class of food appears the most in the food menus?
2. State the factors that were considered when planning the daily menu.
3. Which individual's meal has the highest calorific value?

The Importance of Maintaining Health

According to the research results of the National Health and Morbidity Survey (2016), the percentage of Malaysians with diabetes is 17.5%, high blood pressure is 30%, high cholesterol is 47%, obesity is 17% and overweight is 40%. This problem shows the improper diet and lifestyle of Malaysians. Activities to create awareness should be carried out more actively at school level.

Activity 3.5

Aim: To create awareness and emphasise the importance of maintaining a healthy body.

Instruction

1. Work in groups.
2. Collect information on:
 - (a) heart diseases
 - (b) high blood pressure
 - (c) diabetes
 - (d) skin cancer
 - (e) lung cancer
3. Prepare a poster about the causes of these diseases and steps that can be taken to prevent them.
4. Put up the three best posters on the science notice board in your class.

We need to practise a healthy lifestyle such as eating food with less sugar, salt, oil and fat. Besides, we need to exercise and should not smoke to maintain our health and to reduce the risk of dangerous diseases.

The existence of various high-calorie foods has caused more people to be categorised as obese. Obesity is a problem that not only has a negative effect on the appearance of an individual, but also destroys health without considering age or background.

Science Info

The research results of the National Health and Morbidity Survey 2016 shows that only six percent of Malaysian adults eat enough fruits and vegetables. Thus, the Ministry of Health Malaysia launched the Eat Fruits and Vegetables Campaign.



Photograph 3.9 *Balanced diet can maintain health*

Science Info

Body Mass Index (BMI) is a formula that calculates body mass against height. We can evaluate our body mass index after calculating the BMI.

$$\text{Calculation of Body Mass Index (BMI)} = \frac{\text{Mass (kg)}}{\text{Height (m)} \times \text{Height (m)}}$$

Activity 3.6

Aim: To study the obesity problem among school children and suggest ways to overcome it.

Instruction

1. Conduct a study on the obesity problem among students in your school.
2. You need to study:
 - (a) the relationship between eating processed and junk food and the problem of obesity
 - (b) ways to solve the problem at school level
3. Write the results of your study in the form of a folio.

Formative Practice 3.2

1. What is meant by a balanced diet?
2. State the factors that influence calorific requirement.
3. Compare the energy requirements of a 50-year-old woman and 50-year-old man.
4. Give the definition for calorific value of food.
5. Suraya is a long-distance runner. She has breakfast as shown in the photographs below before going for a practice session. What is the calorific value of the food consumed by Suraya? In your opinion, has Suraya taken a balanced meal? 🍌



A plate of nasi lemak
(400 kcal)



A cup of cornflakes (160 kcal) and a
cup of milk (130 kcal)



An apple (60 kcal)

6. Mr. Robert originates from Switzerland and now lives in Malaysia. Mr. Robert works as a diplomatic officer. He finds that his daily food requirements are less compared to when he was in Switzerland. Why? 🍌

3.3 Human Digestive System

What happens in our body after we eat? How is food like the watermelon in Photograph 3.10 digested? Let us learn about the process of food digestion.



Photograph 3.10

Food digestion is the process of breaking down food that is complex and large into molecules that are small, simple and soluble so that they can be absorbed by the cells of the body.

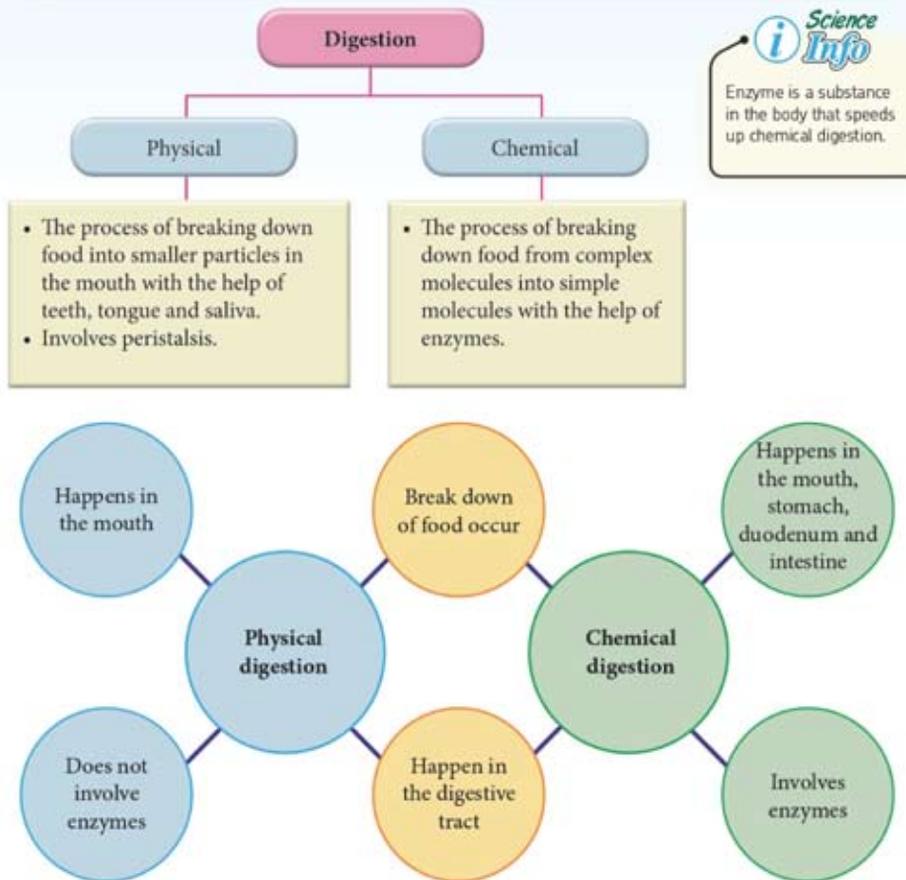


Figure 3.10 Comparison between physical digestion and chemical digestion

The Structure of the Human Digestive System

What are the organs that are involved in the human digestive system? The human digestive system comprises a tube that is called the digestive tract and a few other organs such as the liver, gall bladder and pancreas. The digestive tract is a long tube that begins in the mouth and ends at the anus.

Brain Teaser

If a digestive tract is 9 m long, how does the tract fit into a body that is 1.5 m in height?

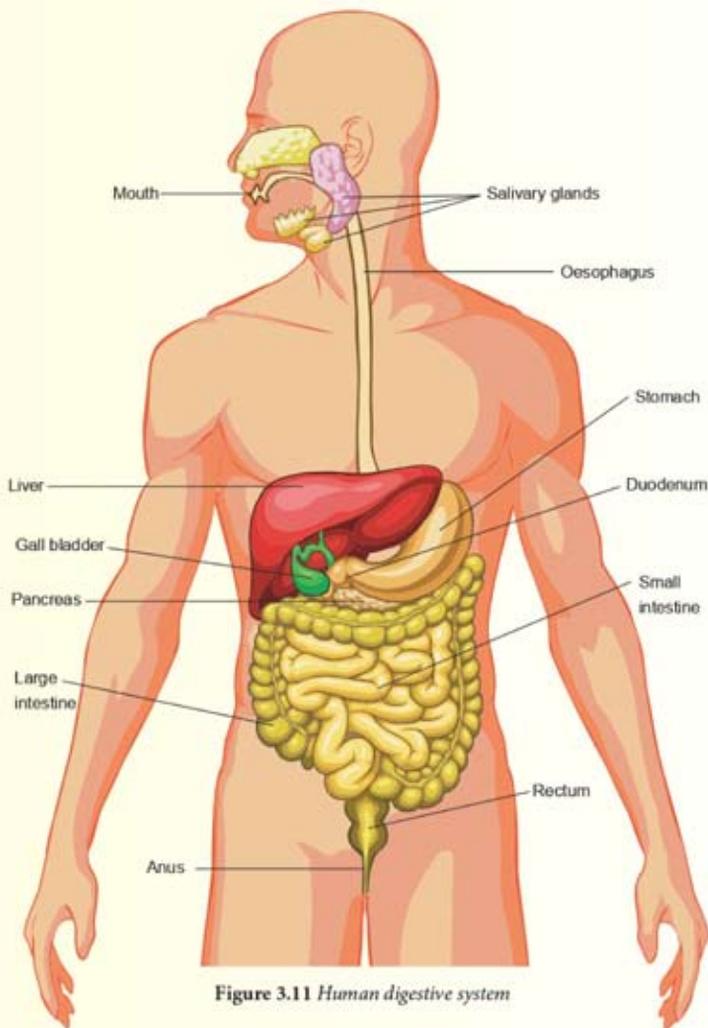


Figure 3.11 Human digestive system



Figure 3.12 The flow of food particles

The Flow of Food in the Digestive Tract

What happens when food passes through each organ in the digestive tract?

1 Mouth

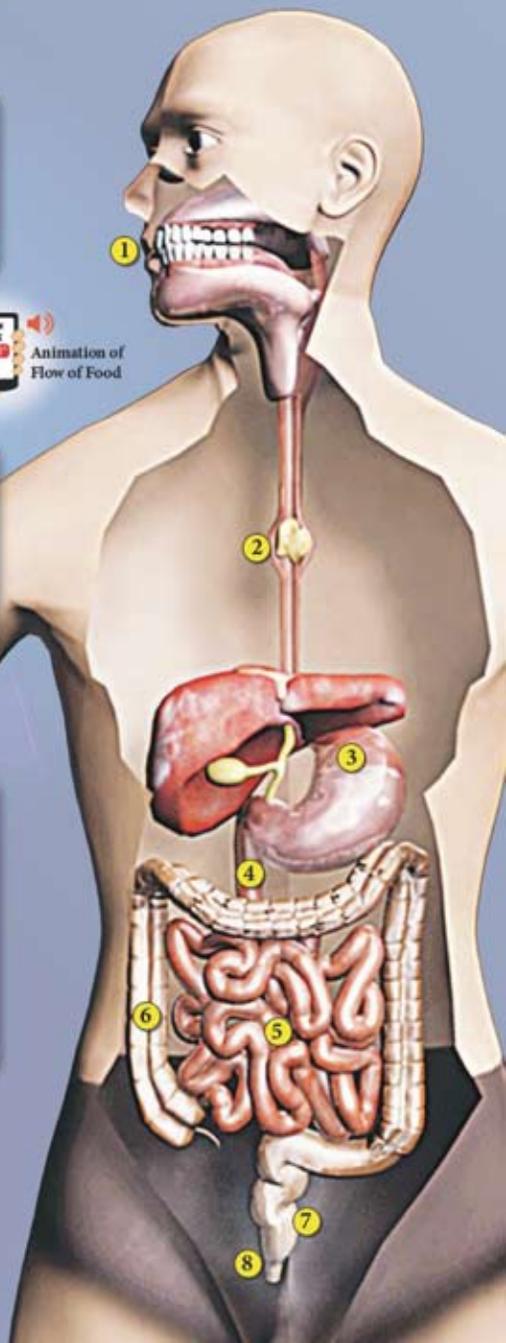
- Food is chewed by the teeth.
- Particles of food are softened by saliva.
- **Salivary amylase** in saliva breaks down **starch** into **maltose**.

2 Oesophagus

- Food that enters the oesophagus is called **bolus**.
- The **process of peristalsis** at the wall of the oesophagus pushes the food into the stomach.

3 Stomach

- Walls of the stomach secrete **protease** and **hydrochloric acid**. Hydrochloric acid activates the protease and kills bacteria in the food that enters the stomach.
- Protease breaks down **protein** into **polypeptides**.
- Food that is semi-liquid is called **chyme**.



4 Duodenum

- Food enters the first part of the small intestine, that is, the duodenum.
- The liver produces bile that is stored in the gall bladder.
- The bile emulsifies fat into small droplets and neutralises the acid in the chyme.
- The pancreas produces pancreatic juice which contain enzymes amylase, protease and lipase.
- **Pancreatic amylase** digests **starch** into **maltose**.
- **Protease** digests **polypeptides** into **dipeptides**.
- **Lipase** digests **fat** into **fatty acids** and **glycerol**.

5 Small intestine

- The small intestine secretes enzymes maltase and protease.
- **Maltase** digests **maltose** into **glucose**.
- **Protease** digests **dipeptides** into **amino acids**.

6 Large intestine

- Undigested food will enter the large intestine.
- The process of water reabsorption happens in the large intestine.

7 Rectum

- Food that is undigested, known as faeces, enters the rectum and is stored here.

8 Anus

- Faeces are excreted from the body through the anus.

Figure 3.13 Human digestive system

Our body produces enzymes to quicken the food digestion. What are the examples of enzymes that are involved in digestion? What is the function of each of these enzymes? **Amylase**, **protease** and **lipase** are examples of enzymes in digestion. Enzymes are made up of protein. Without enzymes, the digestion process happens at a very slow rate.



Some detergents contain enzymes. These enzymes help to remove stains such as blood and oil.

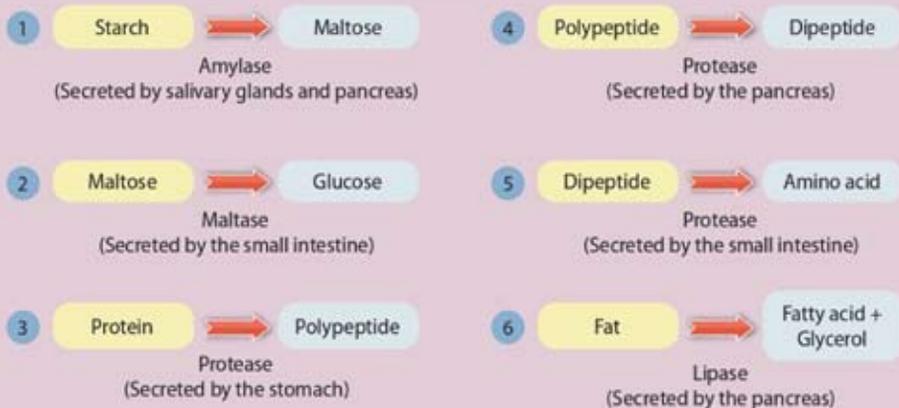


Figure 3.14 Action of digestive enzymes

Activity 3.7

Aim: To study the action of enzyme in saliva on starch.

Materials: 1% starch suspension, iodine solution, Benedict's solution and distilled water

Apparatus: Boiling tube, Bunsen burner, glass rod, wire gauze, 250 ml beaker, test tube, test tube holder, stopwatch, dropper, tripod stand, retort stand with clamp

Instruction

1. Rinse your mouth with distilled water and collect saliva in a small beaker. Use this in step 3.
2. Pour 10 ml of starch suspension into two boiling tubes, *P* and *Q*.
3. Add 4 ml of the saliva into boiling tube *Q*. Stir the mixture with a clean glass rod.
4. Take out 2 ml from each of the boiling tubes and carry out iodine test and Benedict's test.
5. Place boiling tubes *P* and *Q* in a water bath at 37°C and start the stopwatch (Figure 3.15).
6. After 30 minutes, take out 2 ml from each of the boiling tubes and carry out iodine test and Benedict's test.
7. Record your observations in a table.

Note: Students need to rinse their mouth first before starting the experiment.

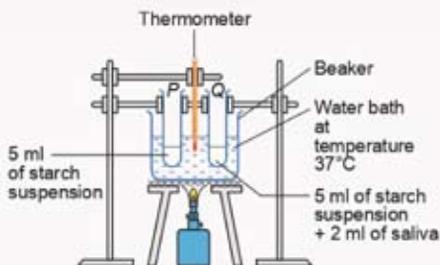


Figure 3.15

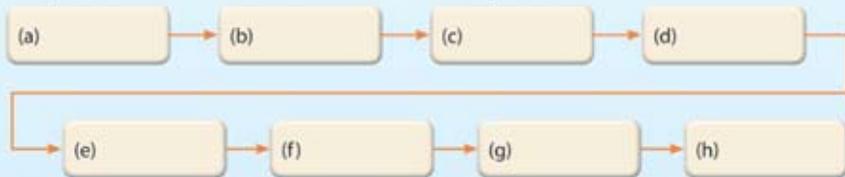
Boiling tube	Food test	Beginning of experiment	End of experiment
P	Iodine test		
	Benedict's test		
Q	Iodine test		
	Benedict's test		

Questions

- Why does the temperature of the water bath need to be maintained at 37°C?
- What happens to the starch in boiling tube Q at the end of the experiment?
- What enzyme is found in our saliva?

Formative Practice 3.3

- What is meant by digestion?
- Complete the flow chart about the flow of food in the digestive tract.



- Name three digestive enzymes and state their function.
- A man with a tumour in his pancreas had a surgery to remove his pancreas. Explain the effect on the process of digestion.

3.4

Process of Absorption and Transportation of Digested Food and Defecation

Observe the surface of the bath towel in Photograph 3.11. What can you see? Observe the thread projections on the surface of the towel. Like the towel, the wall of our small intestine has millions of fine projections called **villi**. This increases the surface area for the process of **absorption** of digested food.

Digested food which is made up of tiny molecules is easily absorbed into the blood circulatory system through the walls of the small intestine. These tiny molecules are then taken to every part of the body. Figure 3.16 shows the structure of a villus and the absorption of digested food in the small intestine.



Photograph 3.11 Thread projections on a towel

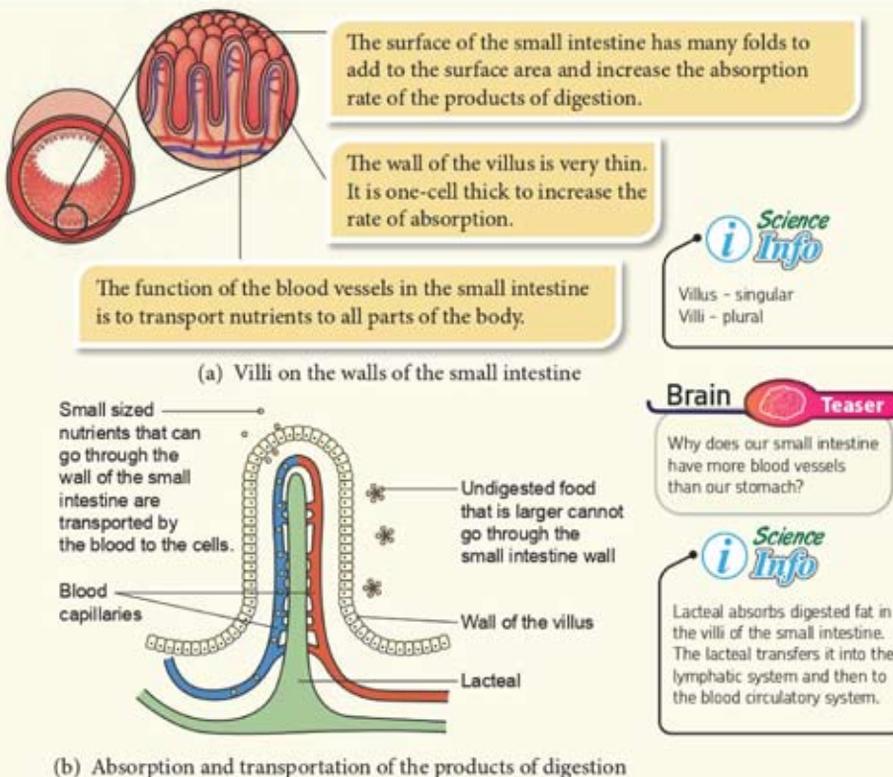


Figure 3.16 Structure of villus and absorption of digested food in the small intestine

Experiment 3.1

Aim: To study the absorption of glucose through a Visking tube.

Problem statement: Can glucose diffuse through a Visking tube?

Hypothesis: Glucose can diffuse through a Visking tube.

Variables:

- (a) Constant variables: Type and size of Visking tube, temperature, time
- (b) Manipulated variable: Content in the Visking tube
- (c) Responding variable: Presence of glucose in the distilled water

Materials: 1% starch suspension, glucose solution, Visking tube, iodine solution, Benedict's solution and distilled water

Apparatus: Boiling tubes, beaker, test tubes, Bunsen burner, stopwatch, tripod stand, wire gauze and thread

Procedure:

1. Soak two Visking tubes in water to soften them.
2. Tie up one end of both Visking tubes using thread.
3. Pour 10 ml of starch suspension into one Visking tube and 10 ml of glucose solution into the other Visking tube.
4. Tie up the other end of both Visking tubes using thread.
5. Rinse both Visking tubes using distilled water until clean.
6. Set up the apparatus as shown in Figure 3.17.
7. Carry out Benedict's test and iodine test on the distilled water in boiling tubes *P* and *Q*.
8. Record your observations in the following table.
9. Leave the apparatus for 30 minutes. Then, repeat step 7.
10. Record your observations in the following table.

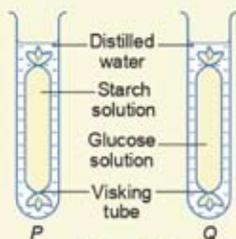


Figure 3.17

Observation:

Boiling tube	Food test	Observation	
		Beginning of experiment	End of experiment
<i>P</i>	Iodine test		
	Benedict's test		
<i>Q</i>	Iodine test		
	Benedict's test		

Questions

1. What is represented by the Visking tube and distilled water in the beaker?
2. State two precautionary steps that need to be taken when carrying out this experiment.
3. What inference can be made based on the observations of
 - (a) boiling tube *P*?
 - (b) boiling tube *Q*?
4. What conclusion can be made from this experiment?

Process of Transporting the Products of Digestion

Food that is digested and absorbed into a villus needs to reach the cells of the body. The molecules that are absorbed into the villus will undergo **assimilation**.

Assimilation is a process of distributing the end products of digestion for the use of the cells in our body.

Our body uses the end products of digestion as follows:

- **Glucose** is used to produce energy.
- **Amino acid** is used to form component of cells.
- **Fatty acid** and **glycerol** combine to form fat which is used as heat insulator and to protect internal organs.

All these three systems below work together to ensure the digested food molecules reach the cells of the body.

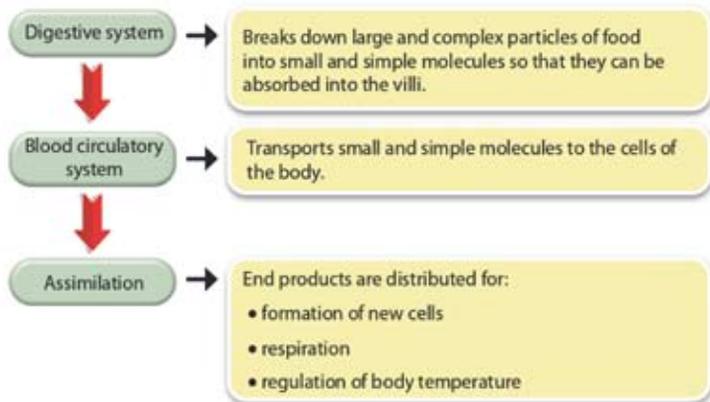


Figure 3.18 Processes involved in the assimilation of digested food

Activity 3.8

Aim: To explain the process of transporting products of digestion by the blood to the cells of the body.

Instruction

1. Work in groups.
2. Collect information from various sources on the process of transporting products of digestion by the blood to the cells of the body for assimilation.
3. Explain how the digestive system, blood circulatory system and respiratory system work together to fulfill the needs of our body.
4. Present the information obtained using a multimedia presentation.

Defecation



What happens to the food that is not absorbed by the small intestine?

Undigested food and food that is not absorbed by the small intestine such as fibres, waste secretions of the digestive tract, dead cells and water will move into the large intestine. While moving through the large intestine, water and minerals are reabsorbed into the blood stream (Figure 3.19). This makes the unabsorbed and undigested food to become solid waste called **faeces**.

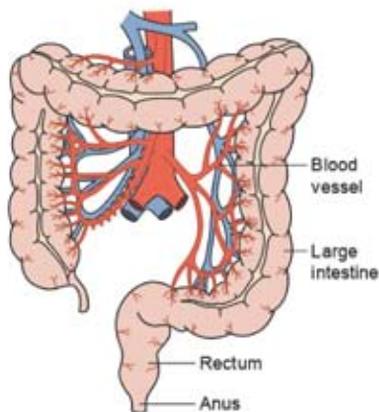


Figure 3.19

Faeces are stored temporarily in the **rectum** before being eliminated through the **anus**. The process of elimination of faeces from the body is called **defecation**.



Activity 3.9

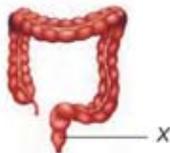
Aim: To create a multimedia presentation about transportation and reabsorption of water by the large intestine and the process of defecation.

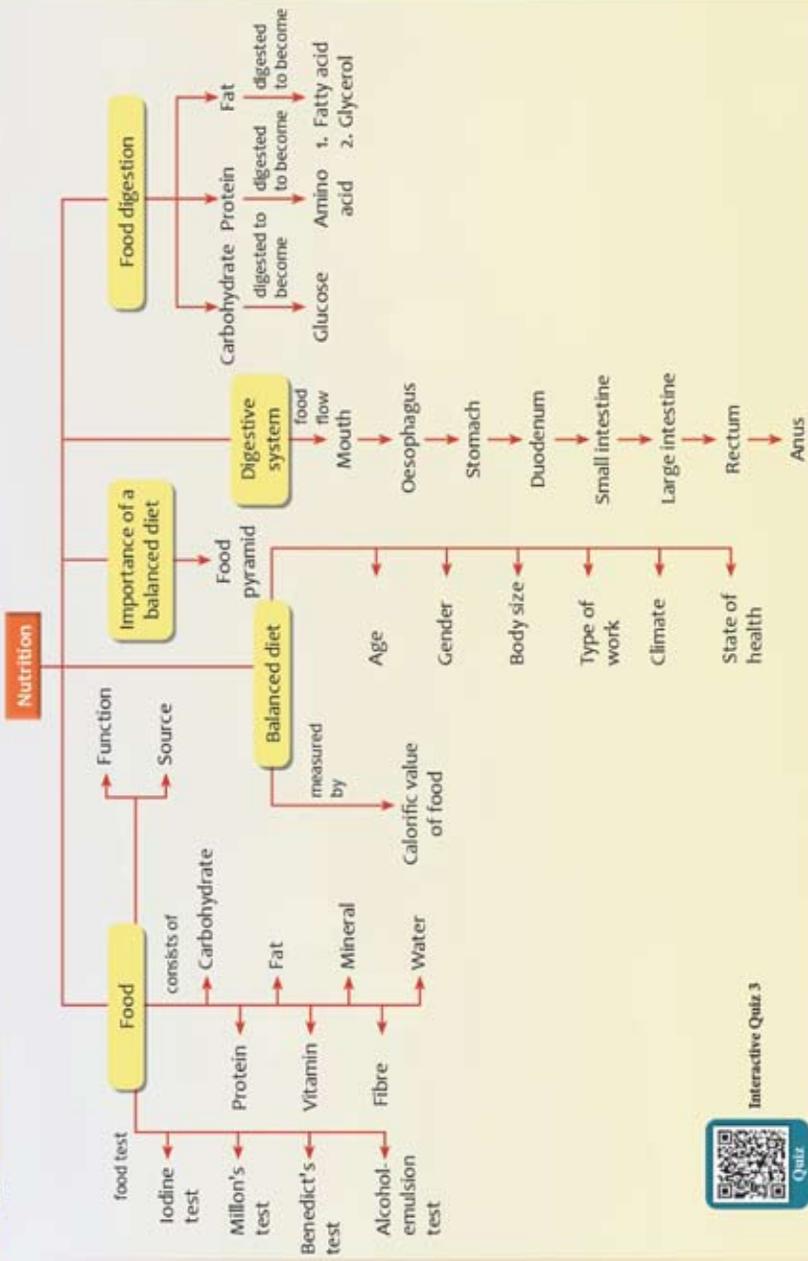
Instruction

- Get information from various sources on the:
 - importance of practising good eating habits to avoid constipation
 - implications to health if imbalanced diet is practised, especially with little or no fibres
- Present the information using a multimedia presentation.

Formative Practice 3.4

- The figure on the right shows the human large intestine.
 - Name X and state its function.
 - What is the movement that helps the movement of undigested food through the large intestine?
 - What is reabsorbed by the large intestine?
- Kusairi does not like eating fruits and vegetables. What is the effect on his health? 





Interactive Quiz 3

Quiz



SELF-REFLECTION

After learning this chapter, you are able to:

3.1 Classes of Food

- Elaborate and communicate on classes of food.
- Test the presence of starch, glucose, protein and fat in food.

3.2 Importance of a Balanced Diet

- Elaborate and communicate on a balanced diet.
- Estimate calories of food intake in a meal and plan a balanced diet.
- Conduct a research and justify the importance of a balanced diet, exercise and a healthy lifestyle in order to maintain a healthy body.

3.3 Human Digestive System

- Elaborate and communicate on digestion.

3.4 Process of Absorption and Transportation of Digested Food and Defecation

- Conduct an experiment to explain the absorption of the end products of digestion.
- Relate the function of digestive system, blood circulatory system and respiratory system.
- Elaborate and communicate on defecation.

Summative Practice 3

1. Figure 1 shows a food pyramid.

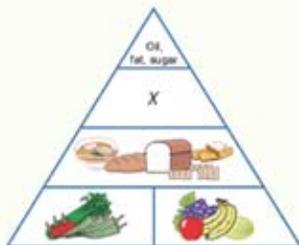


Figure 1

- (a) Name three types of food in the space marked X.
- (b) State the functions of that food.

(c) Amri is 15 years old and is obese. Amri has also been confirmed by the doctor as having diabetes.

- Suggest practices that Amri needs to cultivate to control his health.
- Suggest a balanced breakfast menu that is suitable for Amri.
- In your opinion, what is the cause of his health problems? Justify your opinion.

2. Nicole lives in the Arctic which has a temperature as low as -40°C .

- What class of food should Nicole consume continuously to adapt herself to the cold temperature?
- Give reasons for your answer in 2 (a).

3. Figure 2 shows the human digestive system.

- Identify parts *P* to *W*.
- Name the part where
 - carbohydrate digestion begins
 - protein digestion begins
 - fat digestion begins

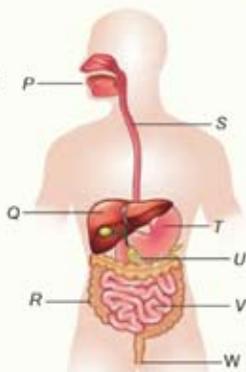


Figure 2

4. Amirah tested two types of food using iodine solution and Benedict's solution. Amirah's observations are as follows.

- Rice – changes colour to dark blue with the iodine test, remains blue with the Benedict's test
- Honey – remains brown with the iodine test, becomes a brick red precipitate with the Benedict's test

- Explain how Amirah conducts the Benedict's test.
 - Create a table to show the results obtained by Amirah in both of the food tests.
 - What is the conclusion that can be made by Amirah?
5. Pui Yee conducted an experiment about the effect of heat on amylase. Amylase breaks down starch to maltose.

- 2 ml of amylase solution is poured into two boiling tubes, A and B.
- Only the solution in boiling tube A is heated. Then, the solution is left to cool down to room temperature.
- 5 ml of starch suspension is added into boiling tubes A and B.
- After 10 minutes, Pui Yee carries out tests for the presence of maltose. Pui Yee finds that maltose is present in boiling tube B only.

- (a) What is the manipulated variable in this experiment? 🧠
- (b) State two constant variables in this experiment. 🧠
- (c) Pui Yee concludes that high temperature destroys amylase. Is her conclusion correct? Justify your answer. 🧠

HOTS Mastery 3

6. Mr. Fuad and Mr. Razak live as neighbours in a village near the sea. Mr. Fuad is a fisherman while Mr. Razak teaches at a school in the village. Photograph 1 shows a set of breakfast for a healthy man.



Boiled egg



Sandwich



Tea



Watermelon

Photograph 1

- (a) Study the set of food. State whether the set is more suitable for Mr. Fuad or Mr. Razak. Justify your answer. 🧠
- (b) Suggest a breakfast set that is suitable for the individual that you did not choose in 6(a). 🧠
7. Read the excerpt below and answer the questions that follow.

A vegetarian does not eat meat, fish or chicken but only eats vegetables for personal reasons. Nevertheless, he can eat products that come from animals such as milk and cheese.

- (a) In your opinion, is the vegetarian's diet healthy? Explain. 🧠
- (b) The vegetarian wants to make a burger. Plan a balanced burger menu for him. Explain. 🧠