CHAPTER 1

Food and Digestion

Why do we need to eat food? What happens to the food after we have eaten it? Is it healthy to eat too much or too little food?

Learning Outcomes

In this chapter, you will learn:

- *to recognise that food is a source of raw materials for the body and energy resource to maintain the body's activities such as growth, repair and movement;*
- *to recognise that food contains a mix of proteins, carbohydrates, fats, vitamins, minerals, fibre and water;*
- *to identify food which is rich in particular nutrients;*
- *to recognise that proteins are important for growth and repair and carbohydrates and fats more commonly provide energy;*
- *to use chemical tests to identify proteins, carbohydrates and fats;*
- *to recognise that a healthy diet contains a balance of foodstuffs;*
- *to explain what is meant by digestion and why food must be digested;*
- *to describe how the human digestive system helps in the digestion of food and the part played by enzymes in digestion;*
- *to recognise that the products of digestion are transported in the blood to other parts of the body and those which cannot be digested are egested.*

1.1 Nutrients in Food

Do you feel hungry looking at the different types of food in the photograph on the previous page? Feeling hungry is a sign that our bodies need food. Our bodies depend on food to give us energy to move around and carry out important life processes.

Food provides us with:

- energy to do work and carry out the vital functions in our bodies;
- the materials needed for the growth of new cells and the repair of damaged cells;
- substances that our bodies need for health and resisting diseases.

Food stores energy and contains nutrients which are essential to our bodies. The different types of nutrients in food may be classified as follows:

- carbohydrates;
- fats;
- proteins;
- fibre;
- vitamins;
- minerals;
- water.

Most types of food contain a mix of different nutrients. However, certain types of food are richer in particular nutrients than others.

Carbohydrates

Carbohydrates supply our bodies with most of the energy that we need. Carbohydrates are compounds made up of the elements carbon, hydrogen and oxygen. Carbohydrates include **sugars** and **complex carbohydrates**. Sugars include simple sugars such as glucose and fructose, and complex sugars such as lactose (from milk), maltose and sucrose (cane sugar). Cellulose, which makes up plant cell walls, and starch are complex carbohydrates.

Starch

Starch is found in food such as rice, potatoes, bread, cereals, noodles, yam, cassava, beans and grains.

Fig. 1.1 Food rich in starch

People from different societies obtain carbohydrates from different food sources as shown in the photographs below. Identify the source of carbohydrates for each type of meal below. What is your main source of carbohydrates?

Fig. 1.2(a) A Western meal

Fig. 1.2(b) A Malay meal

Fig. 1.2(c) A Chinese meal

Fig. 1.2(d) An Indian meal

Fig. 1.2(e) An Italian meal

Testing for starch

The presence of starch in food can be tested by the use of **iodine solution**. A blue-black colour is obtained if iodine solution is added to starch.

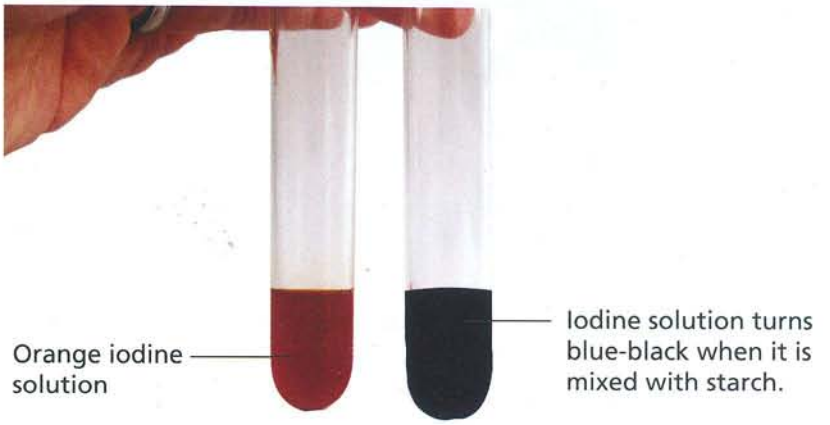


Fig. 1.3 Testing for starch

Sugars

Sugars are found naturally in fruits, sugar cane and milk. Sugars are used to make chocolates, candies, cakes and soft drinks. Food or drinks made from refined sugar such as candies and soft drinks provide us with a lot of energy but little of other nutrients. Hence, it is not advisable to take too much of them. Excess carbohydrates in the body are converted by the body to fats, and stored.

Fig. 1.4 Food rich in sugars

Testing for glucose

The presence of the simple sugar, glucose, can be tested by using **Benedict's solution**, which is light blue in colour. When an equal amount of Benedict's solution and glucose solution are mixed and heated, an orange-red precipitate is formed.

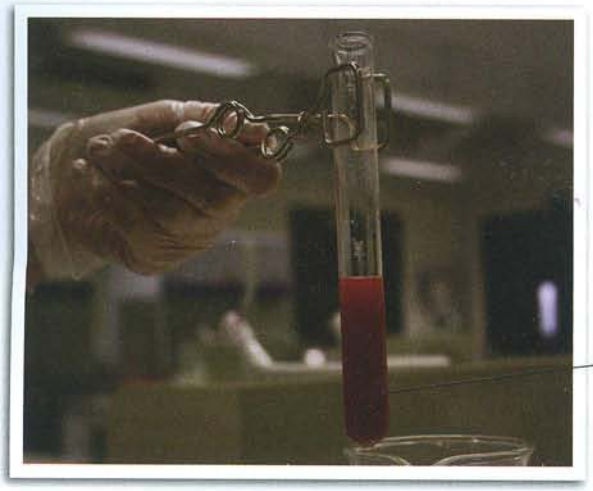


Fig. 1.5 Testing for glucose

Fats

Like carbohydrates, fats are compounds made up of carbon, hydrogen and oxygen. However, fats have less oxygen in proportion to hydrogen. Fats give more than twice the energy as the same amount of carbohydrates. Fats serve as a reserve supply of energy when food consumption is low and help to keep us warm. However, too much fat in our bodies can lead to health problems like heart diseases.

Fats from animals can be found in butter, lard, meat, cheese and milk while fats from plants can be found in margarine, nuts and cooking oils such as peanut oil, palm oil or olive oil. Plant oils and oils from fatty fish such as salmon and mackerel provide us with healthy fats. Animal fats such as lard and butter have high levels of unhealthy fats and should be consumed sparingly.

Testing for fats

The presence of fats in food can be tested by using **ethanol**, a kind of alcohol. When a little ethanol is added to a drop of oil and mixed well, a clear solution is formed. If some water is added to this clear mixture, a white emulsion (fat dispersed in water) is formed.

Fig. 1.6 Food containing fat

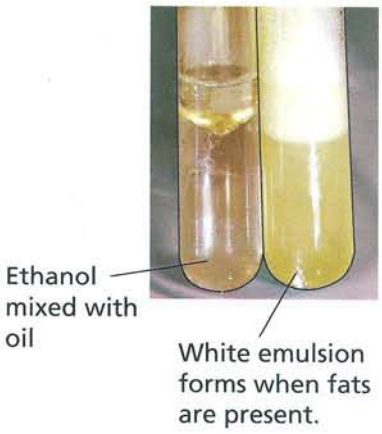


Fig. 1.7 Testing for fats

Proteins

Proteins consist of long chains of amino acids which are made up of the elements carbon, hydrogen, oxygen and nitrogen. There are about 20 different types of amino acids, which link up and combine in various ways to form millions of different types of proteins.

Like carbohydrates and fats, proteins can supply us with energy. However, their main function is to build body cells, tissues, enzymes and hormones. They are essential for growth and repair of worn-out parts of our bodies. Muscles, cartilage and tendons in our bodies are made up of proteins. Deficiency in proteins results in a disease called **kwashiorkor**, which is characterised by loss of body fat, distended belly and wasting of muscles.

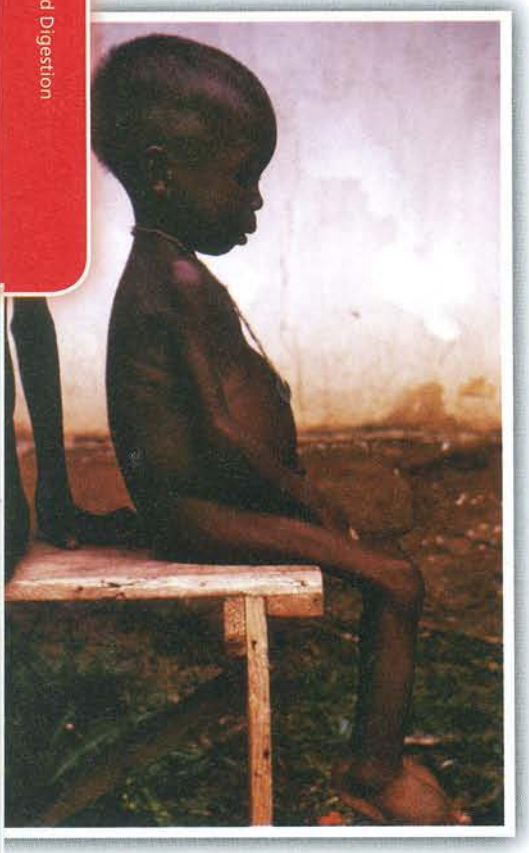


Fig. 1.8 A child suffering from kwashiorkor

We obtain proteins from food which are rich in proteins such as meat, eggs, fish, milk, cheese, beans, nuts and peas.

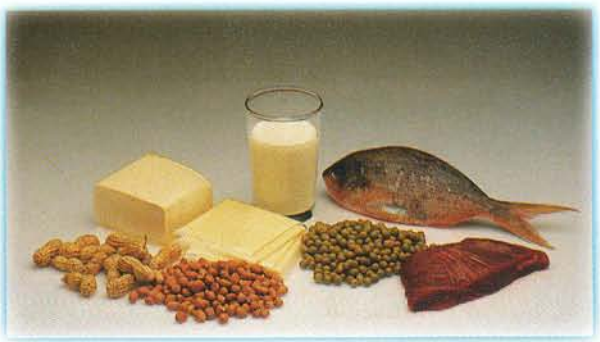


Fig. 1.9 Food containing proteins

Testing for proteins

The presence of soluble proteins in food can be tested by using **Biuret solution**, which is a mixture of sodium hydroxide solution and small amount of copper sulphate solution. A change to violet colour is observed when the blue Biuret solution is mixed with a soluble protein.

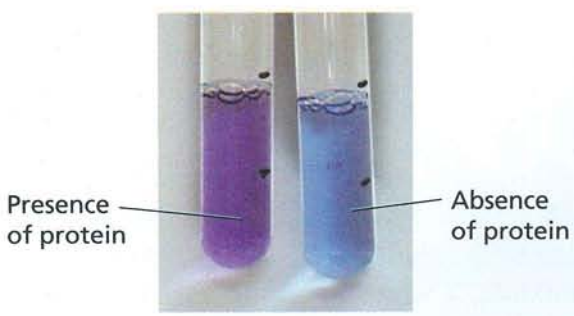


Fig. 1.10 Testing for proteins

Try It Out

Test different types of food for starch, glucose, fats and proteins using the food tests described.

Fibre

Fibre or roughage is made up of cellulose which cannot be broken down by our bodies. It passes right through the body and leave as solid waste in the form of faeces. The right amount of fibre in our diet keeps our intestines healthy and working properly. Without fibre in the diet, one may suffer from constipation.

Fruits, vegetables, brown rice, cereals, whole wheat bread are examples of food which are rich in fibre.

Fig. 1.11 Sources of dietary fibre

Science Tidbits

Animals such as cows, sheep and goats are called *ruminants*. They are able to digest (break down) cellulose with the help of bacteria in their stomachs, each of which has four chambers.

Vitamins

Vitamins are needed in *small amounts* by our bodies for health and growth. Lack of vitamins in the diet can lead to **deficiency diseases** such as scurvy (bleeding gums) and rickets (stunted growth and softening of bones and teeth).

Fig. 1.12(a) A person suffering from scurvy

Fig. 1.12(b) A person suffering from rickets

Vitamins	Functions	Deficiency problems	Food sources
A	• For maintaining healthy skin • For normal vision	• Dry and scaly skin • Night blindness	Carrots, pumpkins, green vegetables, eggs, fish, dairy products
B_1	• For releasing energy from carbohydrates • For proper functioning of the heart and nervous system	• Beri-beri (a disease affecting the nerves and muscles)	Yeast, wholegrain cereals, peas
C	• For healthy teeth and gums • For absorption of iron • For healing of wounds and preventing infections • For formation of collagen (a protein in connective tissues) to hold cells together	• Scurvy (bleeding gums) • Low resistance to infections • Easily bruised	Citrus fruits (e.g. oranges, lemons, limes), tomatoes, pawpaw, guavas, green vegetables
D	• For growth and development of bones and teeth	• Rickets (stunted growth, softening of bones and teeth)	Dairy products, eggs, liver (Our bodies produce vitamin D when sunlight falls on our skin.)
E	• For protecting cells and vital tissues	• Nerve degeneration in hands and feet	Vegetable oil, wheat germ, nuts, egg yolk
K	• For clotting of blood	• Bruises easily • Prolonged bleeding	Vegetables, liver (Vitamin K is also made by bacteria in the gut.)

Table 1.1 Vitamins – functions, deficiency problems and food sources

Some vitamins are water-soluble while others are fat-soluble. Water-soluble vitamins such as vitamin B_1 and vitamin C are more readily removed by the body. Hence, regular intake is needed. Fat-soluble vitamins such as vitamins A, D, E and K are stored in fat tissues where they are slowly released. Vitamins can cause toxicity when taken in excess.

Minerals

Minerals are substances needed by the body in *tiny amounts* for proper growth and development. They are needed in some body tissues and are used in some chemical reactions of the body. The table below shows some important minerals, their functions and food sources.

Minerals	Functions	Food sources
Calcium	• For building strong bones and teeth • For muscle growth and contraction • For clotting of blood	Dairy products, green vegetables, eggs
Iron	• For making haemoglobin, the red pigment in red blood cells • Deficiency leads to anaemia	Liver, meat, eggs, green vegetables
Iodine	• For making hormones of the thyroid gland • Deficiency leads to goitre, a swelling of the thyroid gland in the lower neck (see Figure 1.13 below)	Seafood, seaweed, green vegetables (Table salt often has iodine added to it.)
Sodium	• For regulating our body fluids (Too much sodium leads to high blood pressure.)	Common salt (sodium chloride)

Table 1.2 Minerals – functions of food sources

Water

Water does not provide us with energy, but it plays vital roles in many life processes. Without water, we would die very quickly. Water makes up about 70% of our body mass. It is needed for breaking down food, dissolving nutrients and transporting them around our bodies. Water is the main constituent of cells and blood plasma (the liquid part of the blood). Chemical reactions can only take place in the cytoplasm of cells which contains enough water.

Fig. 1.13 A person suffering from goitre

We lose a lot of water daily through our perspiration, urine and the air we breathe out. The water lost must be replaced. An average person needs about two to three litres of water (6 to 8 glasses) per day. We may also obtain water by eating food such as juicy fruits, which are rich in water.

Fig. 1.14 Fruits and vegtables are rich in water

Try It Out

Young mammals feed on their mothers' milk. Human breast milk is the perfect food for human babies throughout the first year of their lives. Find out why breast milk is far superior to infant formula milk which is mostly based on cow's milk.

Key Points

- Food provides us with:
  - energy to do work and carry out the vital functions in our bodies;
  - materials needed for the growth of new cells and the repair of damaged cells;
  - substances that our bodies need for health and resisting diseases.
- Most types of food contain a mix of different nutrients such as carbohydrates, fats, proteins, fibre, vitamins, minerals and water.
- Carbohydrates are compounds made up of carbon, hydrogen and oxygen and include sugars, starch and cellulose. They supply most of the body's energy.
- Fats are compounds made up of carbon, hydrogen and oxygen. Fats contain more than twice the energy for the same amount of carbohydrates. They keep us warm and serve as a reserve supply of energy.
- Proteins are made up of the elements carbon, hydrogen, oxygen and nitrogen. Proteins are needed to build body cells, tissues, enzymes and hormones. They are essential for growth and repair of worn-out parts of our bodies.
- Fibre or roughage is made up of cellulose which cannot be broken down by our bodies. It passes right through the body and leaves in the form of faeces. The right amount of fibre in our diet keeps our intestines healthy and working properly.
- Vitamins (e.g. vitamins A, C and E) are compounds needed in small amounts by our bodies for health and growth. Lack of vitamins in our diet can cause us to suffer from deficiency diseases such as scurvy and rickets.
- Minerals (e.g. calcium, iron, iodine and sodium) are substances needed by the body in tiny amounts for proper growth and development.
- Water is needed for various life processes and chemical reactions in our bodies, such as digestion and transport of nutrients.

1.2 Energy Value of Food

Carbohydrates, fats and proteins are our main suppliers of energy. The amount of energy in food is known as the **energy value**. The chart below shows the energy values of carbohydrates, fats and proteins.

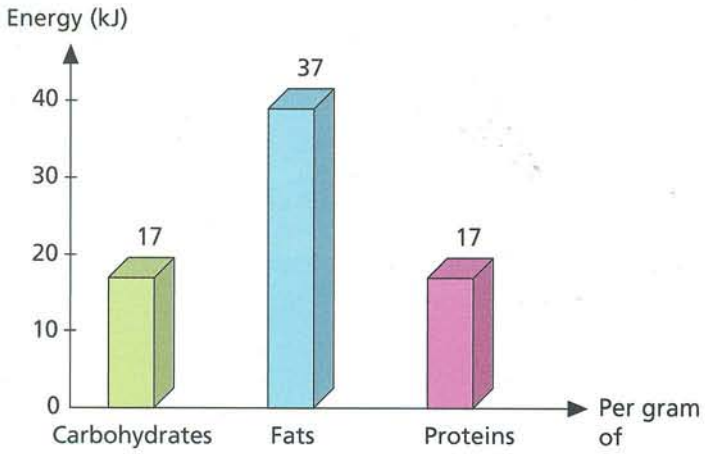


Fig. 1.15 Energy values of carbohydrates, fats and proteins

Look at the chart above. What is the energy value of 1 g of (a) carbohydrates; (b) fats; (c) proteins?

Our bodies commonly use carbohydrates as a source of energy. Fats in our bodies provide us with energy when the carbohydrate intake is low. When neither carbohydrates nor fats are available, proteins are used to supply the body with energy.

Key Points

- Carbohydrates, fats and proteins are the main energy suppliers for our bodies.
- The energy values per gram of carbohydrates, fats and proteins are as follows:
  - carbohydrates 17 kJ/g;
  - fats 37 kJ/g;
  - proteins 17 kJ/g.

1.3 A Balanced Diet

Your diet is what you eat and drink. A varied diet consists of different types of food which supply us with the energy and different types of nutrients which our bodies need.

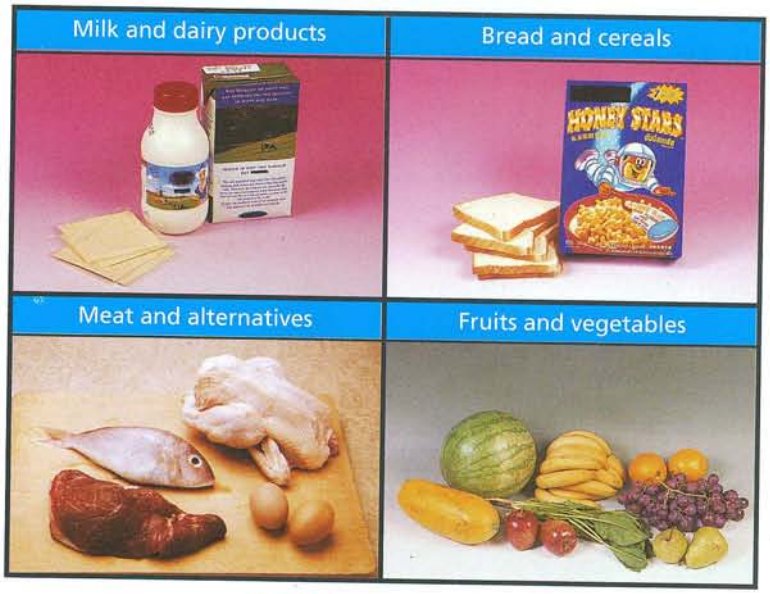


Fig. 1.16 A varied diet

What are the types of food that we should eat? How much of each type of food is good for us? In finding the right answers to these questions, we must first ask ourselves what our bodies need. Energy requirements differ among individuals.

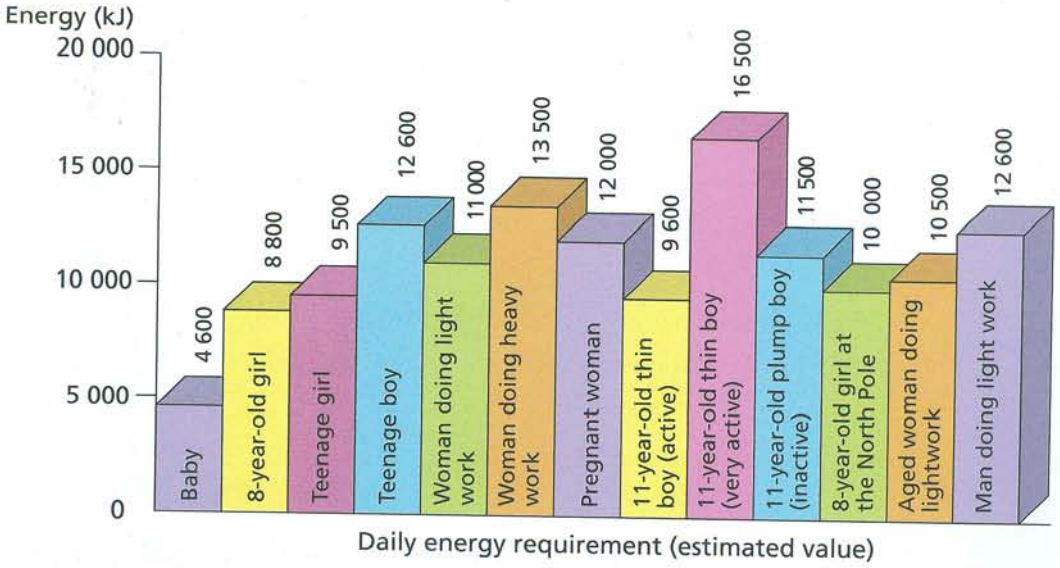


Fig. 1.17 Daily energy requirements of different individuals

Try It Out

Answer the following questions using the bar chart (Fig. 1.17) to find out the factors which affect the daily energy requirements of an individual. In what way(s) will the energy requirement change when:

- the individual grows from a baby to an adult?
- a full grown adult reaches old age?
- the individual is a male instead of a female?
- the individual does more work?
- the individual becomes more active?
- the individual gets pregnant?
- the individual moves from a hot environment to a cold one?
- the individual increases in weight?

Besides energy requirements, people may have other special needs. For example, a growing child needs plenty of proteins for making new tissues. A pregnant mother needs extra proteins, iron and calcium for the developing foetus. An athlete needs proteins for building muscles and plenty of simple sugars for instant energy.

A **balanced diet** contains the right amount of energy, carbohydrates, proteins, fats, fibre, vitamins, minerals and water to meet the requirements of the body.

The *Healthy Eating Pyramid* on the right serves as a guide to the types of food we should take more, and the types we should consume less.

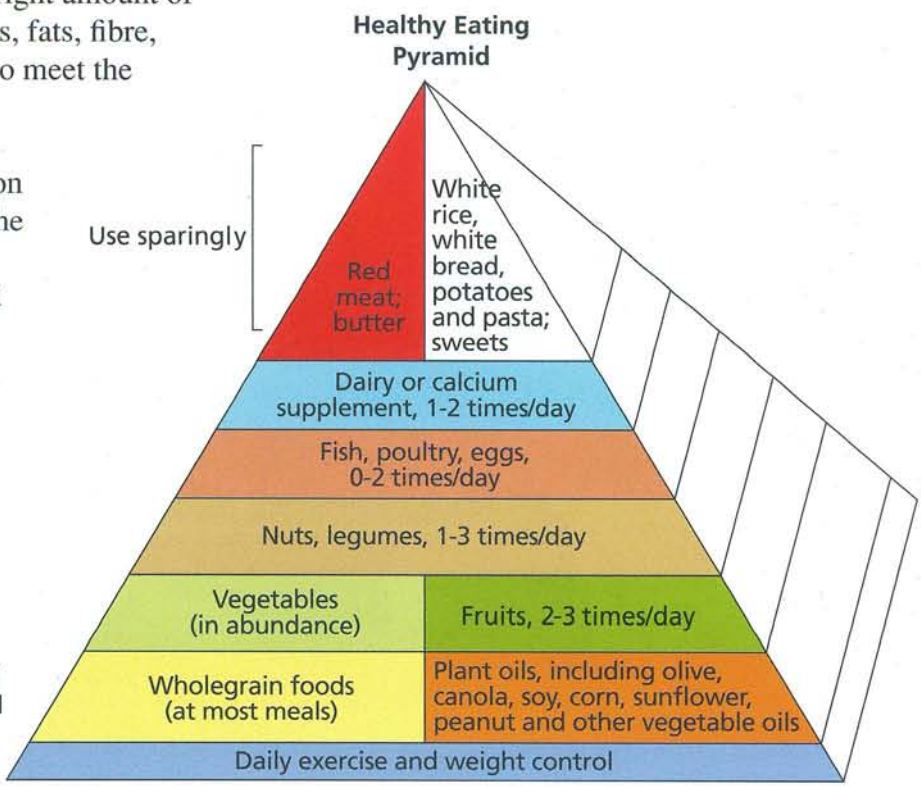


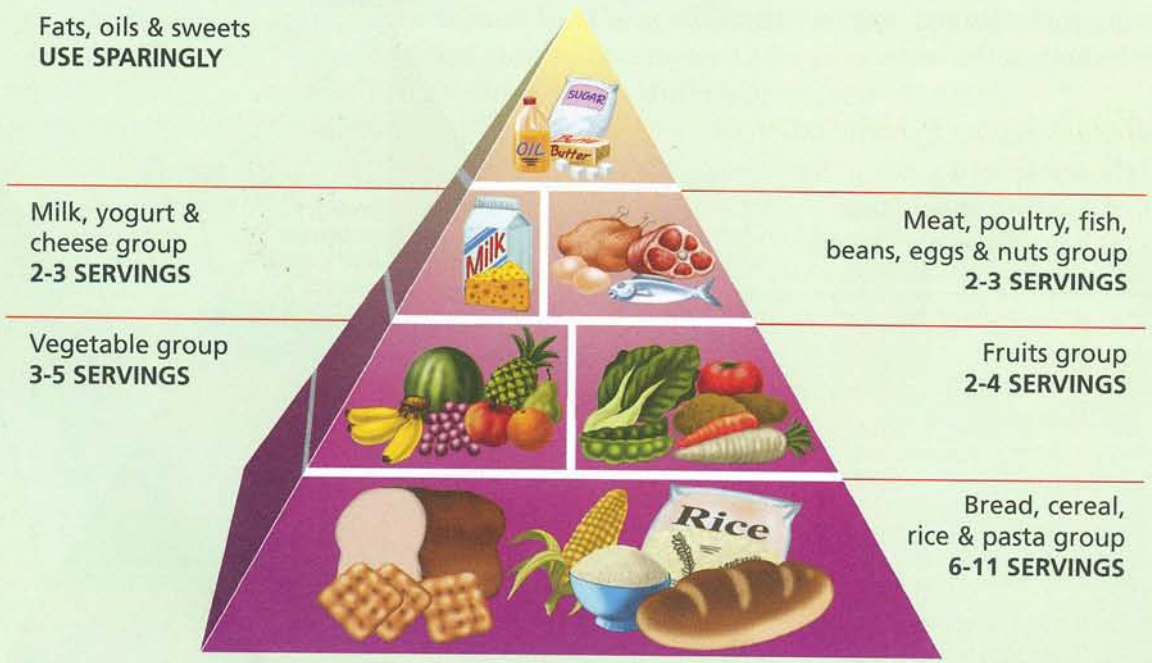
Fig. 1.18 Healthy Eating Pyramid (Source: Harvard School of Public Health)

Based on the *Healthy Eating Pyramid*, a healthy diet should include:

- more carbohydrates from **whole grain food** such as brown rice, oatmeal and whole wheat bread, and less from white rice, potatoes, bread made of refined white flour, pasta and sweets;
- healthy fats, such as **plant oils** (e.g. olive, canola, soy and peanut oils), and those from **fatty fish** such as salmon, and less of fats from other animals such as lard and butter;
- more **vegetables and fruits** to provide vitamins, minerals and fibre;
- a suitable amount of **nuts and beans** to provide vitamins, minerals and proteins;
- a suitable amount of meat such as **fish**, **poultry and eggs** as a source of proteins and little of red meat (e.g. beef and pork) as they contain more unhealthy fats.

Try It Out

As you can see from the *Healthy Eating Pyramid*, some sources of carbohydrates and fats are better than others for our health. Compare this pyramid to the old *Food Guide Pyramid* below. In what way(s) is the Healthy Eating Pyramid better than the Food Guide Pyramid?



Food Guide Pyramid (Source: USDA and the US Department of Health and Human Services)

If the amount of energy taken in is more than what is used up, the extra energy will be stored as fats. This can lead to obesity. Being obese or overweight is not good because obese people are more likely to suffer from heart diseases than people of normal weight. Too much sugar in the diet can also cause obesity and tooth decay while too much salt can cause high blood pressure.

While overeating is unhealthy for us, not eating enough can lead us to malnutrition (not getting enough nutrition). Some people suffer from anorexia because of excessive consciousness towards weight loss. They starve themselves purposely and exercise excessively. As a result, they may suffer from weakness, fatigue and depression. So, you must eat wisely and in moderation to live longer and healthier!

Try It Out

Keep a food diary by writing down the types and amount of food you eat at each meal for one week. Which type of nutrients did you consume the most? Which type of nutrients did you consume the least? Compare what you have eaten to the guidelines given in the *Healthy Eating Pyramid*. Is your diet balanced and healthy? If it is not, take actions to change it!

Key Points

- Energy requirements differ among individuals. If the amount of energy taken in is more than that which is used up, the extra energy will be stored as fats.
- A balanced diet contains the right amount of energy, carbohydrates, proteins, fats, fibre, vitamins, minerals and water to meet the requirements of the body.

1.4 Digestion

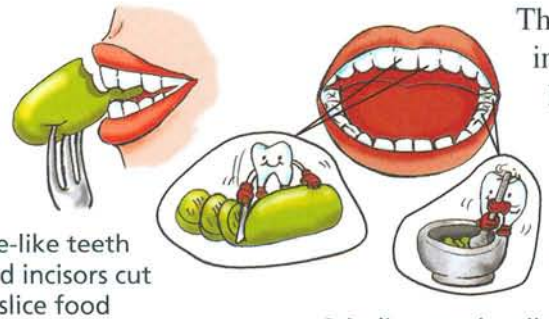
Food provides us with energy and nutrients. The energy stored in the food we eat can only be released in the cells of our bodies in a process called respiration. Similarly, the nutrients in the food have to reach the cells before they can be used for growth and repair.

Most of the food we eat consists of large and insoluble molecules such as starch, fats and proteins which cannot diffuse through the cell membranes into the cells. These large and insoluble molecules have to be broken down into smaller, soluble molecules which can then be absorbed by the bloodstream into the cells. The process of breaking down food into smaller soluble molecules is called **digestion**. Digestion may be physical or chemical.

Physical digestion

In physical digestion, big pieces of food are broken down into smaller pieces. There is no change in the types of molecules and so no chemical reaction takes place.

The teeth help to break big pieces of food mechanically into smaller pieces. Muscles in the stomach also help to break up pieces of food mechanically by churning them. The muscles do this by continually contracting and relaxing themselves.



Knife-like teeth called incisors cut and slice food into small pieces.

Grinding teeth called molars crush small pieces of food.

Fig. 1.19 Actions of the teeth

Try It Out

Eat a piece of biscuit or cookie. Observe the teeth that you used to:
(a) bite the biscuit or cookie;
(b) chew the biscuit or cookie.
Did you use the same teeth for biting and chewing? What teeth did you use in each case?

Chemical digestion

Chemical digestion is the breakdown of large food molecules into smaller ones. Since new molecules are formed, chemical digestion involves chemical reactions.

Starch molecules, for example, are insoluble and too large to pass through the intestinal wall and cell membranes. They have to be broken down into smaller molecules like glucose molecules.

Fig. 1.20 Part of a starch molecule – Each starch molecule is made up of many small glucose molecules joined together.

Glucose molecules are small enough to pass through the wall of the small intestine to get into the bloodstream. The blood carries the glucose molecules to different parts of the body where the glucose molecules diffuse into the cells through the cell membranes.

Chemical digestion is sped up by the action of enzymes. **Enzymes** are special types of proteins produced by the body for bringing about or speeding up specific chemical reactions in the body.

Enzymes that help in digestion are called **digestive enzymes**. Different types of digestive enzymes help to break down different nutrients into smaller and soluble molecules during digestion. An example of digestive enzyme is amylase, which breaks down starch into maltose, a complex sugar.

Fig. 1.21 Starch is broken down by the enzyme amylase into the sugar maltose.

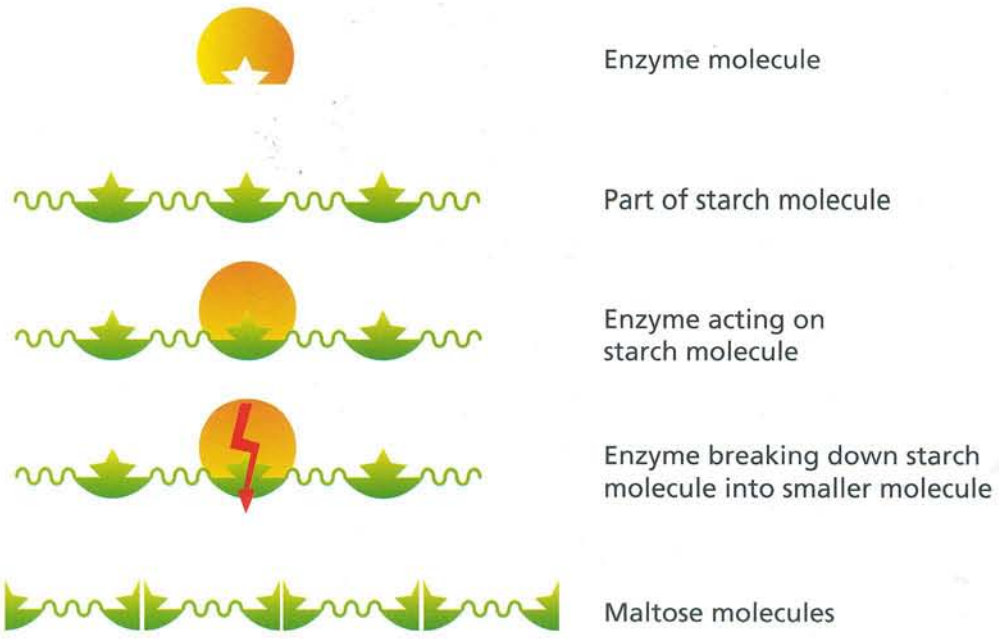


Fig. 1.22 Action of enzyme on starch molecule

Key Points

- Digestion is the breakdown of large insoluble food molecules into smaller soluble ones.
- Food must be digested because most food molecules are insoluble or too large to pass through the cell membranes into the cells.
- Physical digestion is the breakdown of big pieces of food into smaller pieces. It does not involve any chemical reactions.
- Chemical digestion is the breakdown of large food molecules into smaller ones and it involves chemical reactions and the action of digestive enzymes.
- Enzymes are special proteins produced by the body which bring about or speed up certain chemical reactions in the body. For example, the digestive enzyme amylase breaks down starch into maltose, a complex sugar.

1.5 The Human Digestive System

The human digestive system is made up of a tube called the **alimentary canal (gut)**, **liver**, **pancreas** and **gall bladder**. Food travels through the body along the alimentary canal which is a continuous tube beginning at the mouth and ending at the anus.

Science Tidbits

A human body with straight intestines would be nearly 10 m tall! The internal surface area of the small intestine is about 30 m^2. Compare this to the average area of the skin, which is less than 2 m^2.

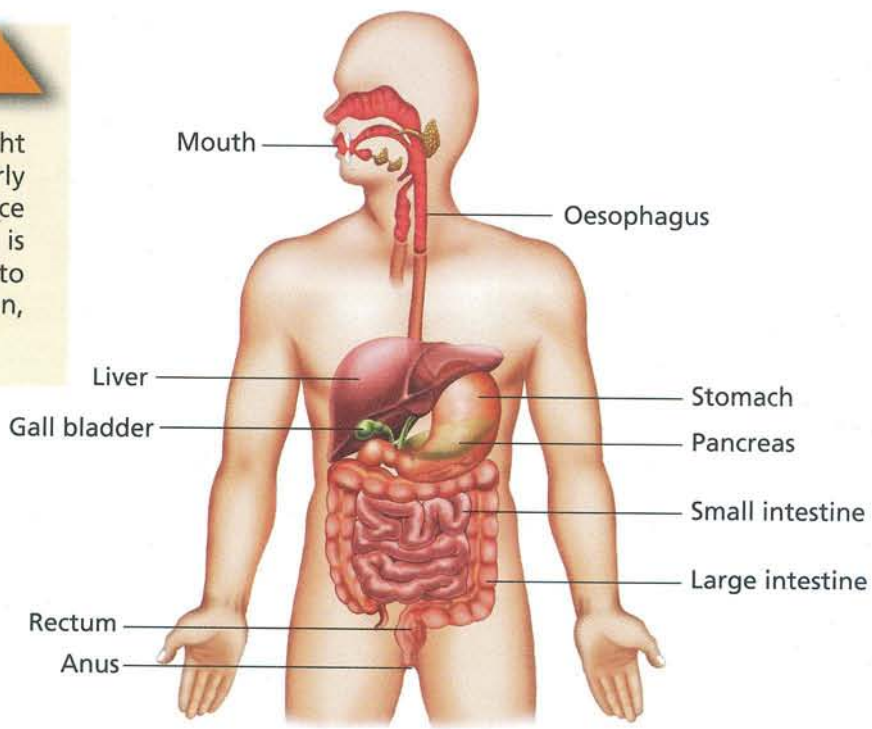


Fig. 1.23 The human digestive system

Mouth

Digestion of food starts in the mouth. The food that we put into our mouths is broken down into smaller pieces by the action of our teeth. Breaking up food into smaller pieces increases the surface area of the food for the digestive enzymes to act on. The food is then mixed with saliva and its enzyme, **salivary amylase**.

Salivary amylase breaks down large starch molecules into smaller maltose molecules. However, food is usually not kept long enough in the mouth for all the starch to be broken down into simple sugars. The tongue rolls the partially digested food into small balls which are then swallowed into the oesophagus or gullet.

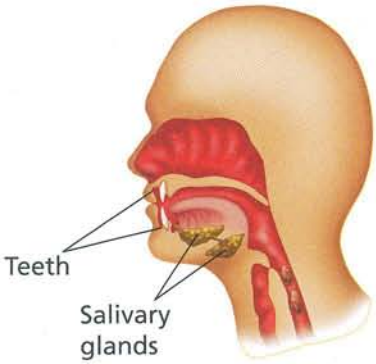


Fig. 1.24 Mouth

Oesophagus (gullet)

The oesophagus (gullet) is a narrow tube with strong muscles in its wall. These muscles contract and relax, producing a wave-like pattern which pushes the food along the oesophagus to the stomach. The involuntary wave-like muscular contractions by which food is moved through the alimentary canal is called **peristalsis**. The function of the oesophagus is to push the balls of food from the mouth into the stomach. No digestive enzymes are produced here.

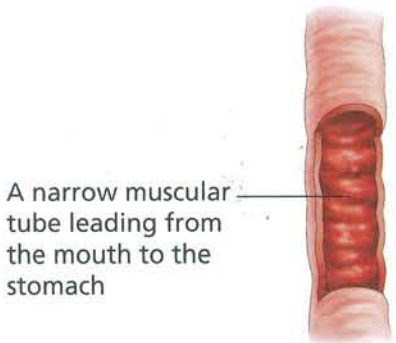


Fig. 1.25(a) Oesophagus

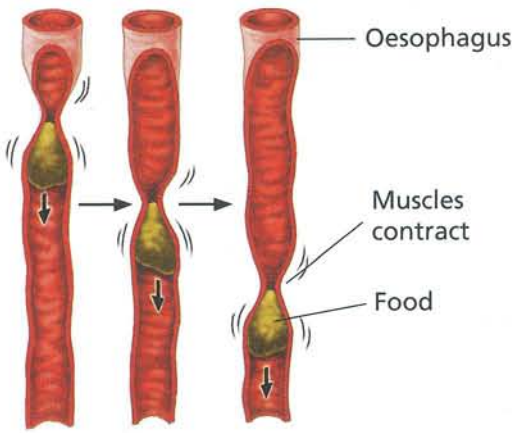


Fig. 1.25(b) Peristalsis

Stomach

The stomach is a muscular organ. Its wall secretes a liquid called **gastric juice** which is made up of **hydrochloric acid**, digestive enzymes called **proteases** and water. The proteases in the stomach digest long chains of protein molecules into shorter protein chains. The hydrochloric acid, which activates the proteases and gets them working, also kills unwanted bacteria that may have been swallowed.

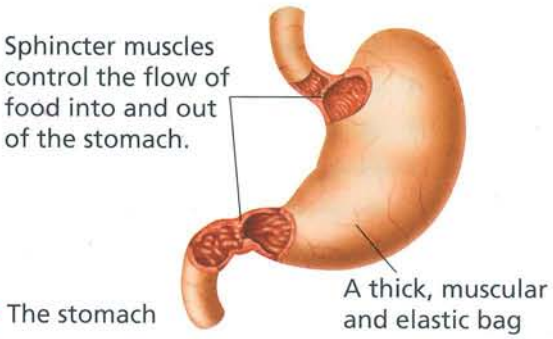


Fig. 1.26 The stomach

Muscular contractions of the stomach wall (peristalsis) churn the food inside the stomach and mix it with the gastric juice. When food leaves the stomach, it has become a semi-liquid mass called chyme, which is released in small amounts at different intervals of time into the small intestine.

Small intestine

As the food emerges from the stomach into the **duodenum** (the first part of the small intestine) a little at a time, **bile** produced by the liver and stored in the gall bladder is squirted onto it through the bile duct. Bile breaks up large fat droplets into smaller fat droplets.

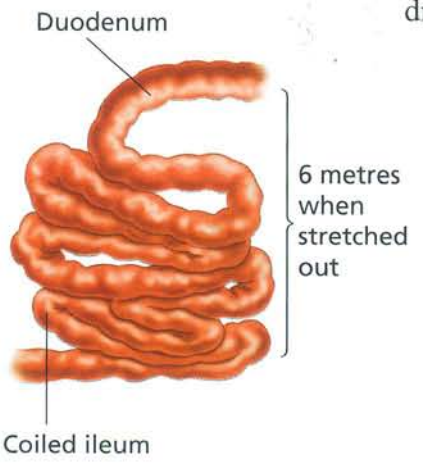


Fig. 1.27(a) Small intestine

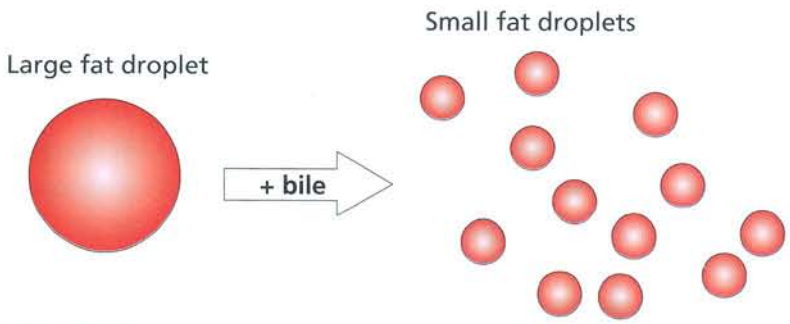


Fig. 1.27(b) How does breaking up the large fat droplets into smaller fat droplets help in digestion? Is breaking up the large fat droplets into smaller droplets a form of physical or chemical digestion?

Pancreatic juice from the pancreas and intestinal juice from the small intestine contain different types of digestive enzymes to digest different nutrients in the small intestine as described below.

- **Lipase** breaks down fats into simple units of fatty acids and glycerol.
- **Proteases** break down the shortened protein chains of the partially digested food from the stomach into small units of amino acids.
- **Carbohydrases**, including amylase from the pancreas, break down carbohydrates which have not been fully digested in the mouth into simple sugars.

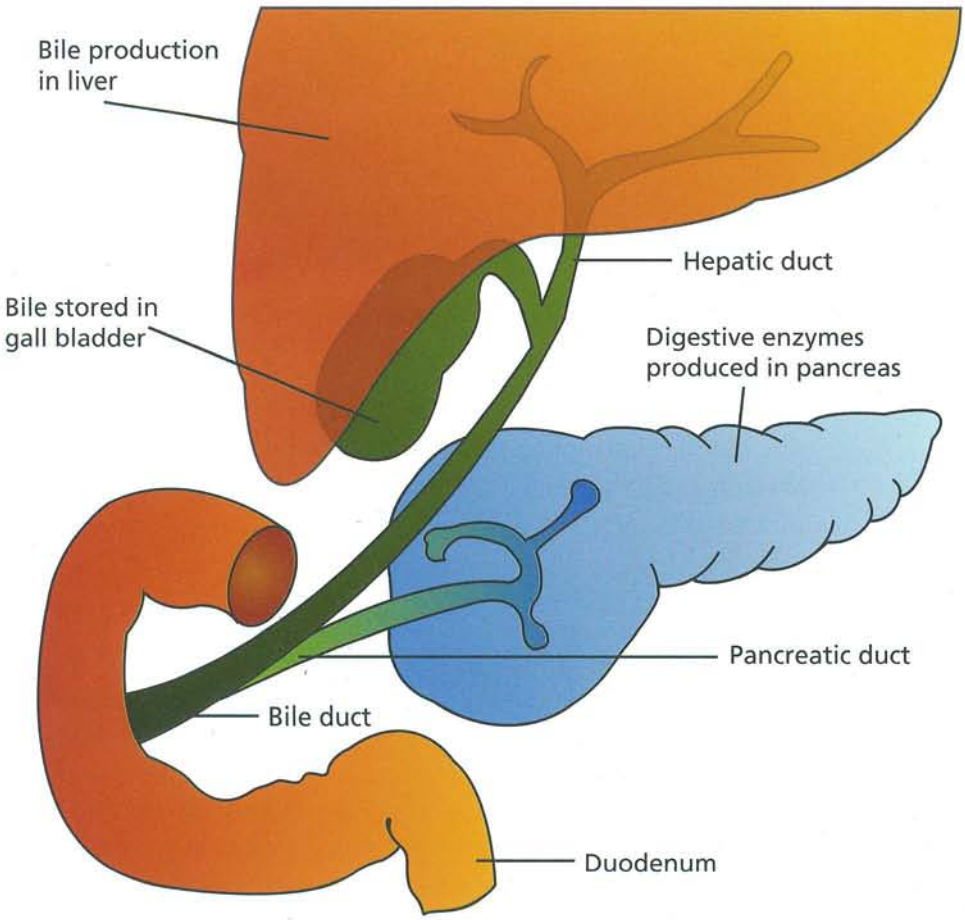


Fig. 1.27(c) Part of the alimentary canal with stomach, liver, pancreas, and gall bladder

Digestion ends in the small intestine. The final products of digestion are glucose, amino acids, fatty acids and glycerol. The digested food molecules are absorbed by the bloodstream through tiny finger-like projections called **villi** on the inner wall of the small intestine. The villi vastly increase the surface area for absorption of the digested food.

Fig. 1.28 How villi look like under the microscope

The digested food molecules which are absorbed are transported by the blood to the cells in the other parts of the body. Undigested food such as fibre, excess water and minerals are passed on to the large intestine by peristalsis.

Large intestine

In the large intestine, excess water and minerals are absorbed into the bloodstream. The remaining undigested contents move into the **rectum** by peristalsis and are stored as faeces. The muscles in the rectum are usually contracted. When ring-like muscles between the rectum and anus relax, the stored faeces will pass out through the **anus**. The removal of undigested matter from the body is called **defecation** or **egestion** (not excretion).

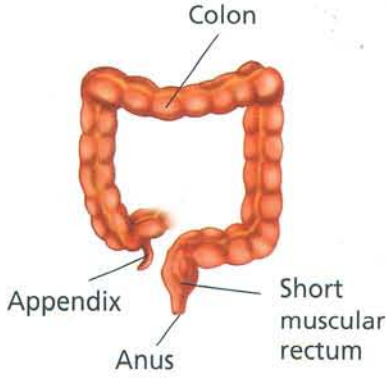


Fig. 1.29 Large intestine

Try It Out

Complete the table below.

Part of alimentary canal	Secretion	Types of enzyme	Action of enzymes in secretion	Other functions
Mouth	Saliva	Salivary _____	_____ → maltose	_____ break down large pieces of food into smaller pieces; _____ rolls food into small balls before swallowing.
Oesophagus (Gullet)	—	—	—	Pushes food from the mouth into the _____ by peristalsis.
Stomach	_____ juices	_____	long _____ chain → shorter _____ chains	Stomach _____ churn up food and mixes it with gastric juice when they contract and relax (peristalsis); _____ acid in gastric juice kills bacteria and activates proteases.
Small intestine	Bile	—	—	Bile breaks up large _____ droplets into small droplets.
	_____ juice _____ juice	Pancreatic _____ _____ _____ Proteases	starch → maltose complex sugars → simple sugars fats → _____ and _____ proteins → _____	Digested food is absorbed into the bloodstream through the wall of the small intestine.
Large intestine	—	—	—	Most of the _____ and _____ are absorbed into the bloodstream. _____ temporarily stores _____ until it is passed out through the _____

Key Points

- The human digestive system consists of the alimentary canal, liver, gall bladder and pancreas. Digestion of food starts in the mouth and ends in the small intestine.
- Salivary amylase in the mouth digests some of the starch into maltose (a complex sugar).
- The oesophagus (gullet) pushes food down from the mouth into the stomach by contracting and relaxing its muscular walls (peristalsis).
- Proteases in the gastric juice produced by the stomach digest proteins into shorter protein chains. Hydrochloric acid in the gastric juice kills bacteria and activates proteases.
- Bile produced by the liver breaks up large fat droplets into smaller fat droplets for the digestive enzymes in the small intestine to act on.
- Pancreatic and intestinal juices in the small intestine contain digestive enzymes which digest starch and complex sugars into simple sugars, fats into fatty acids and glycerol, and proteins into amino acids.
- Digested food is absorbed into the bloodstream through the walls of the small intestine.
- Water, minerals and undigested food such as fibre pass into the large intestine where the water and minerals are absorbed into the bloodstream. The undigested food is stored in the rectum and passed out as faeces through the anus.

Review Questions

1. What does food provide us with?

2. Complete the table below.

Nutrients	Functions	Types of food which are rich in the nutrients
Carbohydrates	Provide _____	• _____ – Fruits, milk, soft drinks, candies; • Starch – _____, cereals, _____, _____
_____	Provide _____ Keep us warm	Milk, cheese, lard, vegetable oil, nuts
Proteins	Provide energy Build _____, enzymes and hormones For _____ and _____ of the body	Milk, dairy products, fish, meat, beans, vegetables
Fibre	Provides roughage to keep _____ working properly	Cereals, _____, whole wheat bread, brown rice
Vitamins	Needed in small amounts for _____	• Vitamin _____ – Carrots, pumpkins, green vegetables; • Vitamin _____ – Citrus fruits, green vegetables; • Vitamin _____ – Dairy products, eggs, liver
_____	Needed by the body in tiny amounts for proper growth and development	• _____ – red meat, liver, green vegetables; • _____ – seafood, seaweeds; • _____ – milk, dairy products; • _____ – common salt
_____	Needed for various life processes and chemical reactions in our bodies, e.g. digestion, _____ of nutrients.	Beverages, juicy fruits

3. What is a balanced diet? Why is there a need for one?

4. A group of sailors on board a ship suffered from bleeding gums. What deficiency disease could they have suffered from? Suggest two types of food which should be included in their diets to prevent such a disease.

5. Suggest why an adolescent like you needs more energy than an elderly person.

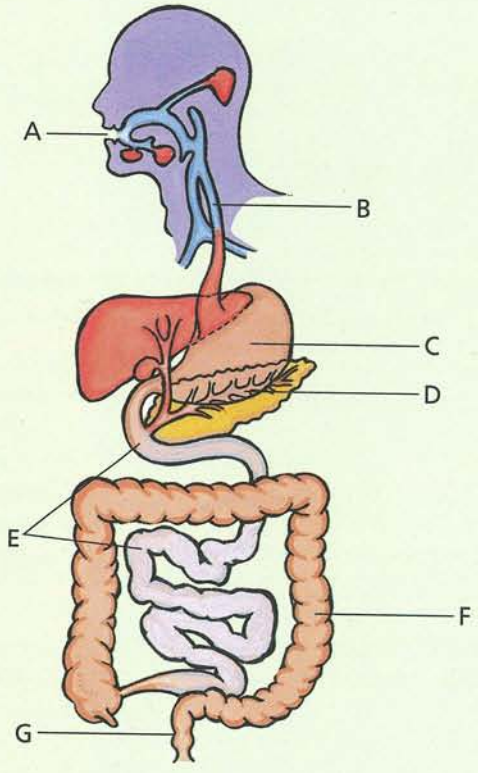
6. What is digestion? Why is there a need for digestion?

7. What is the purpose of breaking up food into smaller pieces in physical digestion?

8. What are digestive enzymes? Give three examples of digestive enzymes and briefly describe their specific functions.

9. How do villi help to increase the absorption of digested food into the bloodstream?

10.



The diagram above shows the human digestive system.

a. Name the parts labelled A to G.
b. In which parts of the digestive system are starch digested?
c. State the functions of B.
d. What is absorbed into the bloodstream in E and F?
e. From which part of the body is undigested food passed out?

Think-tank

1. Imagine you are at King Mac Restaurant. The menu given to you is shown below. From the menu, choose a meal which is balanced and explain why the meal is balanced.

Average helping of	(kJ)	Average helping of	(kJ)	Average helping of	(kJ)	Average helping of	(kJ)	Average helping of	(kJ)
• sausage roll	1700	• buttered rice	3000	• scrambled eggs	500	• ice cream	500	• tea, milk, sugar	200
• baked beans	1500	• lamb chops	3200	• milk	700	• rice pudding	700	• coffee, milk, sugar	200
• pizza	1300	• chips	1500	• chicken	800	• apple pie	800	• lemonade	700
• chicken and rice	2300	• steak	3000	• cheddar cheese	900	• yoghurt	300	• apple	200
• curried beef rice	2500	• bread with butter	1400	• cottage cheese	100	• jelly	200	• banana	300
								• grapefruit	100

2. Suggest three instances when a person needs vitamin supplements. Explain why he or she needs them.

3. Study the food label on a package of corn snack shown below.

Nutrition Facts
Serving Size 1 package
Servings Per Container 1

Amount per Serving

Calories 80 — Calories from Fats 35

	% Daily Value*
Total Fat 4g	6%
Saturated Fat 0.5g	3%
Cholestrol 0mg	0%
Sodium 110mg	5%
Total Carbohydrate 10g	3%
Dietary Fiber 1g	
Sugars 1g	
Protein 1g	

Vitamin A 0% — Vitamin C 0%

Calcium 2% — Iron 0%

*Percent Daily Values are based a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Chloesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 — Carbohyrdate 4 — Protein 4

INGREDIENTS CORN, VEGETABLE OIL, (containing one of more of the following CANOLA, CORN, OR SUNFLOWER, SOYBEAN) OIL, CHEESES (CHEDDAR, ROMANO FROM COW'S MILK), SALT, BUTTERMILK, GARLIC POWDER, DEXTROSE, SUGAR

Is the corn snack a healthy food choice? Elaborate.

4. Suggest why some washing powder contain digestive enzymes.