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Welcome to Science for Cambridge Secondary 1!
This Student book covers Stage 8 of the curriculum and will help you to prepare for your Progression test and for studying Stage 9, and later, your Cambridge IGCSE® Sciences (Biology/Chemistry/Physics).

Using this book
This book is divided into the three main disciplines of science, Biology, Chemistry and Physics, though you will find overlap between the subject areas. Each chapter starts with Science in context! pages. These pages put the chapter into a real-world or historical context, and provide a thought-provoking introduction to the topics. You do not need to learn or memorise the information and facts on these pages; they are given for your interest only. Key points summarise the main content of the chapter.

The chapters are divided into topics, each one on a double-page spread. Each topic starts with a list of learning outcomes. These tell you what you should be able to do by the end of that topic.

Key terms are highlighted in bold type within the text and definitions are given in the glossary at the end of the book. Each topic has a list of the key terms you should understand and remember.

Summary questions at the end of each topic allow you to assess your comprehension before you move on to the next topic.

Expert tips are used throughout the book to help you avoid any common errors and misconceptions.

Practical activities are suggested throughout the book, and will help you to plan investigations, record your results, draw conclusions, use secondary sources and evaluate the data collected.

At the end of each chapter there is a double page of examination-style questions for you to practise your examination technique and evaluate your learning so far.

Answers to Summary questions and End of chapter questions are supplied on a separate Teacher’s CD.

Student’s website
The website included with this book gives you additional learning and revision resources in the form of interactive exercises, to support you through Stage 8.
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People need food! To get the energy and the raw materials we need to live and grow, we can eat plants and other animals. The food we eat is broken down into small particles (called molecules – see page 83) that our bodies can take in and use. This process is called **digestion**.

### Eating the right things

The food we eat is an important part of staying healthy. We need a lot of different substances in our food. Here are some of the main ones:

- **Carbohydrates** are full of energy, which the body can use very easily.
- The body uses **protein** to grow and repair itself.
- **Lipids (fats)** have much more energy than carbohydrate. We need some fat to give us energy but too much can cause health problems.
- We only need tiny amounts of substances called **vitamins** and **minerals** but they are vital in keeping us healthy.
- We can’t digest (break down) **fibre** but we need it to keep our digestive systems healthy.

### Eating the right amount

It isn’t just what we eat that is important to keep us healthy. We need to eat the right amount of food as well. The food we eat contains energy which is measured in **kilojoules**. Your body needs energy for keeping warm, moving about, growing, repairing any damaged body tissues and growing new babies. People need different amounts of energy from their food at different stages of their lives.

<table>
<thead>
<tr>
<th>Person</th>
<th>Daily energy needs / kJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-year-old girl</td>
<td>8900</td>
</tr>
<tr>
<td>13-year-old boy</td>
<td>9500</td>
</tr>
<tr>
<td>female office worker</td>
<td>9500</td>
</tr>
<tr>
<td>male office worker</td>
<td>11 500</td>
</tr>
<tr>
<td>male farm worker</td>
<td>15 000</td>
</tr>
<tr>
<td>pregnant office worker</td>
<td>10 000</td>
</tr>
</tbody>
</table>

If we eat too much, we store the extra energy as a layer of fat. This acts as an energy store, but too much fat is very unhealthy. It is linked to many health problems including heart disease and diabetes. However, if people don’t get enough to eat they will become very thin. They will catch diseases easily because their immune systems cannot work properly. If someone has little or no food for a long period of time they will die.
1 Obtaining food

Looking at labels

Processed food is sold with labels which tell you exactly what is in the food. You can see the balance of the different types of food and the energy it contains has also been worked out for you.

Food is the energy source for your body – it is your fuel. Like any other fuel, it will burn. To work out how much energy is in a food, scientists burn a sample of the food in a calorimeter and measure how much heat is released.

A sample of food is burned inside a closed container; the surrounding water gets hot. The bigger the temperature rise is, the more energy the food has released.

Key terms
- calorimeter
- carbohydrate
- digestion
- fat
- fibre
- kilojoule
- lipids
- mineral
- protein
- vitamin

Summary questions

1 Using three different examples each time, name:
   a) three foods that contain lots of carbohydrates
   b) three foods that are rich in protein
   c) three foods that contain lots of fats.

2 Look at the table opposite. Suggest why:
   a) a 15-year-old boy needs more energy than a 15-year-old girl
   b) a pregnant office worker needs more energy than a female office worker who is not pregnant
   c) a male farm worker needs more energy than a male office worker.

Too much energy from your food over a long time leads to obesity
Too little energy from your food over a long time leads to starvation

Foods are labelled to show the types of food they contain and their energy content in kilojoules
Carbohydrates are a very important food group. For much of the population of the world, carbohydrates make up most of their everyday diet.

**What are carbohydrates?**

There are two main types of carbohydrates: sugars and starches. Sugars are small energy-rich molecules. Starches are long chains of sugar molecules joined together. Bread, potatoes, rice, pasta and cereals are all good sources of starches. Biscuits, cakes, fizzy drinks and sweets are often high in sugars.

Carbohydrates are used in the body to provide energy from respiration. This energy is then used for movement, growth, reproduction, keeping warm and all our body processes. If you eat more carbohydrate than you need, your body stores the extra energy in the form of fat.

**Testing for carbohydrates**

We can use simple chemical tests to discover if a particular food contains carbohydrates. There are two different tests, one for starches and one for sugars.

**Practical activity** Tests for starches and sugars

The **iodine test** for starch: Add iodine solution to the food. If the yellow or orange colour of the iodine solution changes to blue-black, then the food contains starch.

The **Benedict's test** for sugars: Add blue Benedict's solution to the food and heat to above 70 °C in a water bath. If the food contains sugar, the solution will change from blue to green, then yellow, orange and red.

Test a variety of foods for starch and sugars. Present your results in a table.

**Wear chemical splash-proof eye protection. Avoid contact with iodine as it stains skin and clothing. If you have a food allergy tell your teacher before handling food samples.**
You can also measure the energy in different types of carbohydrate foods. Later you can do the same thing for other types of food and compare your results. In this activity you will make a simple calorimeter.

**Practical activity**  The energy in carbohydrates

Measure out a small sample of a starchy carbohydrate food and a sugary food.

Place a known volume of water in a boiling tube.

Carefully burn one of the samples of food. Hold the sample carefully in some tongs and use it to heat the water as shown.

Measure the rise in temperature of the water.

Repeat the experiment with a sugary food – be very careful with this one. Your teacher may demonstrate it.

Think carefully about your experiment. Does all of the energy from the burning food heat the water? Think of some ways you could improve your experiment.

⚠️ Wear eye protection. If you have a food allergy, tell your teacher before handling food samples.

**Obesity, fitness and health**

It is easy to eat too much carbohydrate because most people like sweet and starchy foods. The extra energy is stored as fat. This can result in **obesity**. An adult is obese when they weigh 20% or more above the ideal weight for their height. If people become so fat, it affects their health.

Obesity increases your risk of developing heart disease. You are also more likely to suffer from diabetes and many other diseases. It is a good idea to monitor how much food you are taking in and to keep yourself active so you do not get fat in the first place. This is much easier than dealing with the health problems later.

**Key terms**

- Benedict’s test
- iodine test
- obesity

**Summary questions**

1. Make a list of as many foods rich in carbohydrate as you can. Split them into the starchy foods, the sugary foods and those which contain both.

2. Look at the experiment above ‘The energy in carbohydrates’. What do you think would happen if a bigger sample of food was used? Why do you have to be very careful burning sugar-rich foods?

3. Make a poster about carbohydrates. Find out as much as you can about them and the different types of food from around the world which contain carbohydrates.

Proteins and fats are important food groups. They are both important for health but they are very different.

Protein in food

Protein is needed in your body for growing and building new cells. Meat, fish, cheese, beans and lentils are all foods that contain lots of protein. Protein molecules are made up of long chains of smaller molecules called amino acids. Different proteins are made up of different combinations of these amino acids. We can make some amino acids in our bodies but some of them have to be taken in with our food. These are called essential amino acids.

If you are growing fast you will need plenty of protein in your diet. This is why it is very important that children have a diet containing plenty of protein. Athletes who are training hard and building lots of muscle also need plenty of protein in their diet.

Fats in the diet

Fats contain lots of energy. 1 g of fat contains almost twice as much energy as 1 g of carbohydrate. You need some fat in your diet for your body to make cell membranes and nerve cells. However, fats contain so much energy that if you eat more than you need it is easy to become overweight.

Learning outcomes

After this topic you should be able to:

• describe the importance of proteins and fats in a balanced diet
• describe how to test for proteins and fats, using the equipment correctly and discussing any risks involved
• present the results of your investigations in tables.

Biuret test for protein: Put your food sample in a test tube and add 1 cm³ blue biuret solution. Alternatively, add 1 cm³ sodium hydroxide solution (NaOH) and then add a few drops of blue copper sulfate solution.

If a purple colour appears, the food contains protein.

Try this test on a number of different foods and record your results in a table.

Wear chemical splash-proof eye protection. Sodium hydroxide is corrosive.
The scientific name for fats is **lipids**. They are made up of chemicals called fatty acids and glycerol. Butter and cooking oil are examples of fats, and fatty foods include chips, samosas and donuts.

**Fats and health**

Too much fat in your diet can lead to obesity which increases the risk of many illnesses. Overeating fatty foods also increases the risk of problems in the circulatory system. Fat can be deposited in the walls of your arteries forming an **atheroma**. This makes the arteries narrower so it is harder for the blood to pass through. Blood clots can form and block the blood vessel.

**Practical activity**  **Testing for fats**

Rub a piece of food on a filter paper. Leave the paper to dry for a few minutes. Hold the paper up to the light. If it becomes translucent (lets the light pass through) the food contains fat.

Try this test on a number of different foods and record your results in a table.

**Key terms**

- amino acid
- atheroma
- essential amino acid
- lipid

**Summary questions**

1. Do some research about proteins. Make a poster to explain to mothers what proteins are and why they are important in a child’s diet.

2. Record all the different foods you eat for two days. Make a table with three headings: carbohydrate, protein and fat. Put the foods in the different columns. They may go in more than one, e.g. milk goes in fat, carbohydrate and protein.

3. **a)** Use your data from question 2. Make a bar graph to show how many of your foods contain each of the three food groups.

   **b)** Which of the food groups do you eat most of? Is this what you expected?

   **c)** In what ways might you improve your investigation? What would you need to do to investigate how much of each food group you eat?
1.4 Vitamins, minerals and fibre

Everything that small babies need to eat and drink comes from their mothers’ milk or from special milk in a bottle. As babies get older, milk is no longer enough. For the rest of our lives we need a range of foods to give us a balanced diet. In addition to carbohydrate, protein and fat we also need vitamins, minerals and fibre to remain healthy.

Vitamins

Vitamins are chemicals that we need in tiny amounts but without which we soon become very ill. We don’t digest vitamins – they are just taken straight into our bodies from our food.

If we don’t get enough vitamins in our diet, we get illnesses called deficiency diseases. For example, vitamin C is found in oranges, lemons and limes and lots of green vegetables. We need it for healthy gums and skin. Centuries ago, sailors on long sea voyages didn’t get fresh fruit and many of them died of scurvy, the disease caused by lack of vitamin C. Once citrus fruits were taken on voyages, deaths from scurvy stopped.

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>How it is used by the body</th>
<th>Deficiency disease</th>
<th>Good sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>For healthy skin and good night vision</td>
<td>Night blindness</td>
<td>Oily fish, green vegetables, dairy products, carrots</td>
</tr>
<tr>
<td>B1</td>
<td>Healthy nerves and the release of energy from food</td>
<td>Beriberi – exhaustion and loss of weight</td>
<td>Wholegrains, eggs, nuts, yeast, liver, pulses</td>
</tr>
<tr>
<td>C</td>
<td>Protection of the cells and absorption of iron</td>
<td>Scurvy</td>
<td>Citrus fruits, blackcurrants, tomatoes</td>
</tr>
<tr>
<td>D</td>
<td>For absorbing calcium</td>
<td>Rickets</td>
<td>Dairy produce, oily fish, eggs and it is made in the skin in the sunshine</td>
</tr>
</tbody>
</table>

Minerals

You also need tiny amounts of minerals in your diet to keep healthy. As you grow, your bones get bigger. The mineral calcium makes bones hard and strong. You get lots of calcium when you drink milk or eat dairy products.

You can run fast because your blood carries lots of oxygen to your muscle cells. You need the mineral iron for your blood to carry oxygen properly. Without it you feel tired and weak. You get iron by eating foods, such as red meat and apricots.

Regular habits

The food we can’t use is usually pushed out of our bodies as faeces within about 24 hours. If our food doesn’t move through the body
quickly, the result is constipation. Some people take medicines, called laxatives, to make themselves go to the toilet regularly. However, there is a much healthier way of keeping things moving in your gut. We don’t use all the food we eat, for example we cannot digest the cellulose from plant cells. We call this material fibre, and it helps to keep the food moving through the digestive system. Fruit, wholemeal bread, bran, beans and sweetcorn have a lot of fibre.

**Practical activity**  
**Daily doses**

It is important to get just the right amount of all the different nutrients. Guideline daily allowances (GDA) are published. Your teacher will give you some tables showing the GDAs for different parts of the diet.

- Look up the food types you have met so far and make a list of the amounts of each you should eat every day to remain healthy.

**Key terms**

- deficiency diseases
- fibre

**Summary questions**

1. Make a table to show three different minerals, their importance in the diet and some good sources. Make your table like the one for vitamins in this topic.

2. Lack of vitamin D and lack of calcium both cause rickets. Explain why deficiencies of vitamin D and calcium cause rickets.

3. Make a poster explaining why fibre is an important part of a healthy diet.