5 THE SCIENCE OF FOOD 113
  Properties of food 114
  Processes that cause changes during food preparation and cooking 115
  The pH scale 115
  Enzymes 117
  Aeration 118
  Protein 120
  Meat 125
  Poultry 128
  Seafood 128
  Milk 130
  Protein in plant foods 131
  Sugar 132
  Starch 134
  Fats and oils 139
  Preparing for exams 141
  Recipes 142

6 AUSTRALIAN EATING PATTERNS 199
  Patterns of eating in Australia 200
  Social factors that aid food choice 206
  Preparing for exams 214

7 THE SOCIAL AND EMOTIONAL ROLES OF FOOD 217
  The social and emotional role of food 218
  Emotional and psychological responses to food marketing 223
  Role of emotional and psychological responses in developing body image 224
  Restrictive dieting 226
  Comfort eating 229
  Preparing for exams 231
8 THE ROLE OF THE MEDIA IN SHAPING FOOD INFORMATION

The role of the media in shaping food information 234
Marketing 234
News reportage 242
Social media 249
Preparing for exams 257

9 CONSUMER BEHAVIOUR AND THE PRESENT FOOD SYSTEM

What is a food system? 260
Australia’s present-day food system 261
Overconsumption of food 263
Sedentary behaviour 269
Establishing healthy diets in children 272
Modelling healthy eating patterns for children 272
Preparing for exams 278

10 FEEDING THE WORLD – GLOBAL FOOD SECURITY

Feeding an increasing world population 282
What is food security? 283
Solutions to global food insecurity 288
Preparing for exams 297

11 ETHICAL FOOD PRODUCTION 299

Ethical principles for Australian consumers 300
Consumer concern about animal welfare 300
Sustainable food production 308
Fairtrade 315
Preparing for exams 319

12 ENVIRONMENTAL SUSTAINABILITY IN PRIMARY FOOD PRODUCTION 321

Farming practices and sustainability 322
Biosecurity and climate change as risks to sustainability in food production 336
Preparing for exams 343

13 DEVELOPMENTS IN SUSTAINABLE FARMING AND FOOD PRODUCTION 345

Challenges for Australian agriculture 346
Genetically modified food production 346
Low-impact farming 352
Organic food production 355
Preparing for exams 361
14 THE IMPACT FOOD PROCESSING, RETAILING AND CONSUMPTION ON ENVIRONMENTAL SUSTAINABILITY 363
Impact of food processing and on the environment 364
Food packaging and the environment 369
Food transportation 378
Food waste 380
Preparing for exams 385

15 THE PROCESS OF INQUIRY AND RESEARCH 387
Inquiry process 388

16 BECOMING AN INFORMED FOOD CONSUMER 395
Contemporary contexts in which we learn about food 396
Individual and family responses to food information 396
Community responses to food information 399
The principles of research 404
Food fads, food trends and diets 407
Analysing claims made by a weight-loss or nutrient supplement companies 409
Practical ways to apply the Australian Dietary Guidelines in everyday life 415
Preparing for exams 420

17 FOOD LABELLING 423
Food labelling in Australia and New Zealand 424
Nutrition content claims and health claims 429
Advantages of accurate food labelling information 432
Reading food labels carefully 434
Preparing for exams 437

Glossary 438
Index XX
## Eating Food

### Satiety

<table>
<thead>
<tr>
<th>Satiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty</td>
</tr>
<tr>
<td>Full</td>
</tr>
</tbody>
</table>

## Sensory Appreciation of Food – The Enjoyment of Food

Our senses work together to help us enjoy food.

- Appearance
- Aroma
- Flavour
- Texture

### Foods with a High Level of Satiety

- Meat
- Fish
- Poultry
- Dairy foods
- Pasta
- Long-grain rice
- Multigrain bread
- Soya beans
- Kidney beans
- Lentils

### Foods with a Low Level of Satiety

- Snack foods
- Pastries
- Sweet biscuits
Digesting Food

Types of Digestion

Chemical
The breakdown of food using chemicals such as enzymes and acids

Mechanical
The use of force to break down food such as chewing or the squashing movement of the intestines

Macronutrients

Carbohydrate
Used in the body to provide a source of energy

Protein
Used in the body for growth, repair and maintenance of body tissues

Fats
Used in the body as a concentrated source of energy, source of vitamins A, D, E and K

Eating and Digesting Food

Key Terms

Appetite is the desire for food.

Chemical digestion is the breakdown of food using chemicals such as enzymes and acids.

Digestion is the process by which food is broken down into substances that can be absorbed and utilised by the body.

Enzymatic hydrolysis is a chemical digestive process that breaks down food by breaking the bonds that hold together the molecular ‘building blocks’ within the food.

Flavour is a combination of the taste and aroma of food.

Glycaemic index (GI) is a measure of how fast and how much a food raises blood glucose levels.

Hunger is the drive to satisfy the need for food.

Macronutrients are the essential nutrients required by the body in large amounts.

Mechanical digestion is the use of physical force to break down food, such as chewing or the squashing movement of the intestines.

Satiety is a state or feeling of fullness after eating food.

Saturated fats contain the maximum amount of hydrogen.

Sensory appreciation of food is the information humans get from their senses about food and how they interpret that information.

Sensory properties of food are the characteristics of foods as they are perceived by the senses – sight, smell, taste, touch and hearing.

Trans fats are created artificially by a process called hydrogenation.

Unsaturated fats can be monounsaturated or polyunsaturated fats.
What is food and why do we eat it?

The basic need for food comes from the body's requirement for the nutrients found in food to ensure our survival. Food contains nutrients that provide energy, promote the growth and repair of tissues, and regulate body processes. This is referred to as the physiological function of food.

We choose and eat food for many reasons other than survival. Our appetite, the desire for food, is conditioned by factors that influence our food choices.

Hunger and appetite are two reasons for eating food but they are not the same thing.

WHAT IS HUNGER?

Hunger is the drive to satisfy the need for food. Your body lets you know when you are running low on fuel and this is the sensation of hunger. Hunger instinctively protects the body from exhausting energy reserves.

Hunger is the result of chemical changes in the body. When glucose levels in the bloodstream are low – they fluctuate naturally several hours after eating – the body produces hunger pangs to let you know it is time to eat and restore the blood glucose levels. The sensation of hunger occurs after the food from the previous meal has been digested and absorbed. Hunger is controlled by a small gland at the base of the brain called the hypothalamus, which also regulates appetite, thirst and body fluids.

WHAT IS APPETITE?

Appetite is defined as the desire for food, even when the body is not hungry. Appetite, or appetite conditioning, may be explained as a conditioned response to food; that is, it can be triggered by the sight of appealing food, the aroma of food, or even the mention of food in conversation. For example, when you sit down to eat pizza for dinner, the sight and aroma of the pizza causes a sensory response. This results in stimuli that cause you to salivate (your mouth waters); simultaneously, a tingling sensation occurs in the pit of the stomach that strongly encourages you to continue to eat pizza. Unlike hunger, if appetite is not satisfied, it will eventually go away.

Do we usually eat because we are hungry or do we eat for pleasure? The answer, of course, is that we often do both! We often eat even when we aren't hungry, enticed by the tantalising aromas and the visual appeal of food even when that empty feeling has long passed. Initially, feeling comfortably full is a pleasant feeling. However, if we continue to eat, we can start to feel bloated and, in extreme cases, nauseous.

Satiety

Satiety is the state of fullness after eating and when there is no further desire for food. Foods differ in their ability to give us a sense of satiety. This is the result of the nutrients they contain and the way in which they are processed and prepared. The foods that provide

HUNGER

![Pizza](https://iStock.com/vikif)

If you are hungry, one or two slices of pizza will satisfy your hunger.

Some components of the pizza will be converted to glucose and absorbed into the bloodstream, which raises the blood sugar levels and stops hunger pangs.

APPETITE

![Pizza](https://iStock.com/Aslan Alphan)

It is your appetite that causes you to reach for another slice and then another and perhaps another.

Your appetite is conditioned by the appearance, aroma, flavour and texture of the pizza, and encourages you to eat more, even after your hunger is satisfied.
the greatest level of satiety are high-protein foods such as meat, fish, poultry and dairy products.

The group of foods next most likely to satisfy hunger are high-carbohydrate foods, especially those with a low **glycaemic index (GI)** – the glycaemic index is a measure of how fast and how much a food raises blood glucose levels. These high-carbohydrate, low-GI foods delay the onset of hunger because they break down slowly during digestion. Foods with a low GI include wholemeal pasta, wholegrain bread, soya beans, kidney beans and lentils.

Foods with a high fat content do not satisfy hunger as well as those of protein or carbohydrate origin. One of the main dangers for the modern consumer is that we are often enticed by advertising to select processed foods or fast foods, which are energy dense rather than nutrient dense. These foods often have a high fat and/or high sugar content and can provide more energy than is needed and don't satisfy hunger for long.

### Satiety levels of food

<table>
<thead>
<tr>
<th>High-protein foods</th>
<th>Low glycaemic index foods</th>
<th>High-fat foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat, fish, poultry, dairy foods</td>
<td>Pasta, long-grain rice, multigrain bread, soya beans, kidney beans, lentils</td>
<td>Snack foods, pastries, sweet biscuits, potato chips</td>
</tr>
</tbody>
</table>

Foods with high levels of satiety

Foods with low levels of satiety

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### Appreciating food

As humans, our choice of food is strongly influenced by our senses or **sensory appreciation of food**; that is, the information we get from our senses about food and how we interpret that information.

The look, feel and even sound of food can change the way it tastes, and all our senses work together with our memory in the enjoyment of food. Food manufacturers, chefs and cooks are aware that consumers choose foods with their eyes first, then with their ears and fingers, and lastly with their nose and tongue. In fact, understanding the **sensory properties of food**, that is the characteristics of foods as they are perceived by the senses of sight, smell, taste, touch and hearing, enables us to describe and explain to others why we enjoy or dislike particular foods. Being able to identify the characteristics of a recipe that need to be altered to improve the appeal of a food product is a useful skill for a cook, chef or food scientist. When we are eating food, our sense organs work together to determine our response to everything we eat.

### The senses

#### Appearance

Looking at food, using our sense of sight to observe the appearance of food is the way most humans first assess food. It doesn’t matter how good the food tastes, if it is not visually appealing, most people are reluctant to eat it.

Colour plays a major part in the perception of food. We expect yellow cordial to have a lemon flavour, and strawberry-flavoured foods to be pink or reddish in colour. The colour of food also serves as a useful guide for judging its quality, and indicates any deterioration or spoilage, the degree of ripeness or the level of cooking.

We use our eyes to assess the shape and size of food. This is a very important consideration for primary producers of fresh fruit and vegetables, for example, as most consumers today will choose unblemished, even-sized produce.

We consider a variety of colours and textures when planning meals to ensure sensory appeal.

#### Colourful fruit and vegetables have appealing sensory properties.

#### Aroma

Aroma refers to the smell or ‘bouquet’ of food. The smell of food is created by the many chemicals in food. We can only identify four or five basic flavours, but we can detect thousands of different aromas. Many different chemicals are responsible for the aromas we associate with particular foods. We detect the chemicals from food as they escape into the air, and
then are inhaled by the nose to reach the olfactory cells. Our senses of taste and smell work together to distinguish the sometimes minute differences between food, for example between the aroma of ripe and unripe strawberries.

When foods are heated, the aromas are often accentuated because the chemicals are more volatile. This explains why hot foods have a stronger aroma than cold foods. Our sense of smell also helps us judge the safety of foods because ‘off’ flavours are often obvious to the nose. As our senses of smell and taste are so closely linked, if we hold our nose while eating or if we have a cold, it is difficult to identify the exact flavour of foods.

**FLAVOUR**

*Flavour* is a combination of the taste and aroma of food. Flavour is the total sensory impression formed when food is eaten. The ability to detect an array of flavours and aromas varies between people and influences an individual’s likes and dislikes of particular foods. Some people find strong flavours, such as curry, overpowering, whereas others really enjoy the spiciness, full flavour and aroma of these dishes. The salty taste of ingredients such as olives, fish sauce and feta cheese is very appealing to some, while others find their flavour too strong.

Taste sensations begin when the papillae or taste buds on the tongue are stimulated. As food is placed into the mouth, the water in saliva begins to dissolve the flavour chemicals. At the same time, the olfactory cells in the nose detect the aromas of the food, and the nerve endings in the skin within the mouth detect the food’s temperature. The taste buds are concentrated on the tongue and detect specific tastes such as sweet, sour, salty and bitter.

There is a fifth taste associated with Japanese and Chinese cuisine – umami. This taste is sometimes referred to as savoury, delicious, more-ish or meaty. The umami flavour is not detected in a specific taste zone on the tongue; rather the flavour is detected by a combination of taste zones. Many centuries ago, Japanese cooks discovered that the use of stock made from seaweed produced a delicious meaty flavour, which they loved. Umami occurs in other foods such as tomatoes, parmesan cheese and salami. Some cooks and food manufacturers use monosodium glutamate (MSG) to create the umami taste.
TEXTURE

Texture is the tactile sense or the way the food feels in the mouth. We can use our eyes and describe the appearance of the surface of food; we can feel the physical structure of food with our hands, and our tongue and skin inside the mouth experiences the mouthfeel of food. We feel the effervescence of a carbonated soft drink, an astringent sensation from unripe bananas, the pungency of wasabi or fresh chilli and the cooling of menthol from a peppermint lolly. We determine the ripeness of fruit by gently squeezing it, and when chewing food we can feel if it is smooth, crunchy, firm, moist, lumpy or hard.

The temperature of food is felt in the mouth – the coldness of ice-cream or the heat of a hot chocolate drink is important to our enjoyment of particular foods.

The texture of food is sensed when it is chewed. The food can feel chewy and cohesive like chewing gum, or sticky like honey, or give a feeling of mouth-coating like peanut butter. The sound of food being eaten also links with texture – the crisp, crunchy sound of potato chips is well known.

ENJOYMENT OF FOOD

Food is more than just nutrients and a means of satisfying hunger. While it must meet the body’s physiological demands, it must also satisfy certain psychological and social needs.

Looking at food before it is eaten

You may see food in a market or supermarket, in a picture in a recipe book, in a TV advertisement or on a plate. This is the first stage in the enjoyment of food and it engages all your senses. You begin to make a visual judgement about the food: What will it taste like? Does it look appetising? You might imagine the sound of food when it is being prepared, such as the sound of a steak sizzling on a barbecue or the snap of fresh beans. Your sense of smell will also begin to work and will soon combine with your sense of taste to provide the expectations of a full flavour sensation. The aroma of fresh bread baking in a local bakery makes your mouth begin to water and entices you to buy the bread.

Putting food in your mouth

The next stage is to transfer the food to your mouth. This may be done with a knife and fork or spoon, or fingers or chopsticks. At this point, you begin to physically interact with the food and can make judgements about its flavour, texture and temperature.
Chewing and swallowing food
The food inside your mouth is now being chewed and swallowed. The flavour is being sensed by the taste buds on the tongue and the different tastes can be distinguished. Mouthfeel can now be determined as you chew and move the food around in your mouth in preparation for swallowing.

Choosing this food again
If eating this food was enjoyable and satisfying, you will probably choose to eat it again or recommend it to others. A positive experience will also be imprinted in the memory.

Understanding the text
1. Draw a diagram to demonstrate the factors associated with the sensation of hunger.
2. What is appetite and how does it influence the amount of food we eat?
3. How does hunger differ from appetite?
4. Explain what is meant by satiety.
5. Explain why the appearance of food influences our enjoyment of what we are about to eat.
6. Describe how we smell the different aromas of food. How does temperature affect the aroma of food?
7. Explain how we detect the flavour of food.
8. How is the umami taste different from the four major taste sensations?
9. Explain how we determine the texture of food.
10. List the four main stages in eating food.

Digestion

Digestion is the process by which food is broken down into substances that can be absorbed and used by the body for energy, for growth and to repair and build new tissue. During this process the large particles in food are broken down into smaller components that can be readily absorbed into the bloodstream.

Digesting food involves both mechanical processes and chemical processes.

MECHANICAL DIGESTION
Mechanical digestion is the use of physical force, such as chewing or the churning or squashing movements of the stomach or intestines, to break down food. This mechanical process begins in the mouth as the teeth tear, cut and grind the food into smaller pieces that can be swallowed without choking. The muscular walls of the oesophagus, stomach and intestines continue the mechanical processes by pushing food along and churning and breaking it into smaller particles.

CHEMICAL DIGESTION
Chemical digestion is the breakdown of food using chemicals such as enzymes and acids. Chemical processes occur at every point in the digestive system, beginning when food is first seen or smelt. The sensory properties of appearance and aroma set off nerve impulses from the eyes and nose. These nerve impulses then trigger the release of enzymes that will eventually break down food and release the nutrients contained in the food.
Chemical digestion is often referred to as enzymatic hydrolysis or a chemical process, such as the release of enzymes, that breaks down food by breaking the bonds that hold the molecular ‘building blocks’ within the food together.

THE DIGESTIVE PROCESS
The digestive system
<table>
<thead>
<tr>
<th>BODY PART</th>
<th>FUNCTION</th>
<th>DIGESTIVE ACTION</th>
</tr>
</thead>
</table>
| Eyes and nose   | Digestion begins with the eyes and ears sending messages to the brain, which sends messages to other body parts. These parts of the body respond to the sight or appearance of food and to the aroma or smell of food, creating a sensory appreciation of the food to be eaten. This sends signals to the brain that enjoyable food is about to be placed in the mouth. | The response to this message causes:  
  - the mouth to water – saliva is produced  
  - the stomach to contract causing hunger pangs  
  - intestinal glands to start the production of digestive chemicals. |
| Tasting and chewing | When food is placed in the mouth both mechanical and chemical digestive processes take place. The teeth bite off pieces of food and chew the food into manageable pieces. The tongue helps to move the food around in the mouth. The salivary glands release saliva, containing an enzyme called salivary amylase. The tongue helps to push the food towards the sphincter, which opens to allow food to pass into the oesophagus. | In the mouth the smaller portions of food combine with the saliva to form a ‘ mushy’ bundle called a bolus, which can easily slide down the throat. Enzymes in the salivary amylase begin to digest the carbohydrates in the food. The food then enters the oesophagus through a muscular valve called the sphincter that opens and allows the food to be swallowed. The epiglottis prevents food from entering the windpipe and channels food down the oesophagus. |
| Swallowing food | As food enters the oesophagus, its passage is assisted by a ‘rush’ of saliva. The bolus (small, soft ball of food) then passes down the oesophagus. | The oesophagus is ringed with muscles that contract and relax to form wavelike motions called peristalsis. The bolus is pushed towards the stomach. A muscular valve at the base of the oesophagus opens to allow the food to enter the stomach. |
| Digesting food | The bolus enters the stomach. The walls of the stomach are strong and muscular. They contract with sufficient force to further break down the food as glands in the stomach release a mixture of gastric juices made up of enzymes and acid. | The stomach wall churns the bolus and the wavelike contractions squeeze the thick mass along to the first section of the small intestine – the duodenum. A liquefied mass called chyme is produced. The stomach juices containing pepsin begin the chemical digestion of proteins into amino acids. Hydrochloric acid helps destroy bacteria. |
| The small intestine | The small intestine is made up of three parts: Once in the duodenum, the first section of the small intestine, pancreatic fluid containing digestive enzymes is released. | Enzymatic hydrolysis is a chemical digestive process that breaks down food by breaking the bonds that hold the molecular ‘building blocks’ within the food together. In enzymatic hydrolysis, reactions occur when an enzyme incorporates a water molecule across the bond, allowing it to break. |
THE MICROBIOLOGY OF THE INTESTINAL TRACT

The microbiology of the intestinal tract refers to the microbes or microscopic living organisms such as bacteria that live in the small and large intestine of all human beings. The intestinal tract is a complex ecosystem and contains over 400 species and over 100 trillion individual bacteria called microflora. The large intestine is densely populated with a microbial ecosystem; however, the small intestine is home to a smaller quantity and fewer species of these microflora.

These microflora or bacteria perform many important and useful metabolic and fermentation activities in the intestine. They improve digestion and the absorption of short-chain fatty acids and assist with the synthesis of vitamins B and K. They are particularly important in aiding the digestion of lactose, reducing diarrhoea in lactose-intolerant people. The microflora also improve the body’s resistance to infections through their ability to repress the growth of harmful microorganisms or pathogenic bacteria.

Microflora also assist with the digestion of fibre by fermenting indigestible carbohydrates such as pectin, cellulose and hemicellulose; they also collect the energy from these otherwise indigestible products. Without intestinal microflora, the human body would be unable to use some of these undigested carbohydrates.

The importance of probiotics and prebiotics in the intestinal tract

In recent years, health professionals have identified two groups of functional ingredients that can be added to traditional foods to give them functional properties to assist with digestive and bowel health. These ingredients are known as probiotics and prebiotics and they help to optimise the health of the digestive system by adding to and supporting the natural microflora present in the intestine.
**Probiotics** are live microbial food supplements such as the *Bifidobacterium* and *Lactobacillus* bacterial species, or foods that have naturally occurring live bacteria such as fermented foods. When probiotics are added to foods, or fermented foods are eaten, they have significant health benefits for the consumer. Many diseases and antibiotics can have a negative impact on intestinal flora and cause a disturbance in the balance of microorganisms in the intestine. This may in turn affect people’s health and ability to digest food and absorb nutrients. Probiotics are often referred to as ‘good bacteria’ because they are said to restore the balance of these important bacteria or microflora in the intestinal tract.

One of the most widely recognised probiotic foods is yoghurt, especially yoghurt that has live cultures such as acidophilus, bifidus and lactobacillus casei cultures added to it. Other examples of probiotic foods include fermented cabbage dishes such as kimchi and sauerkraut, fermented soybean foods such as miso, and kefir, a type of fermented cow, goat or sheep’s milk.

**Prebiotic** components are compounds in food products or those that are added to food products that are non-digestible. Prebiotic components feed bacteria by stimulating the growth or activity of naturally occurring colonic bacteria, thereby improving health. Defined as dietary fibre, resistant starches and non-starch polysaccharides are two substances that can be metabolised by colonic bacteria to allow the bacteria to grow. To be classified as a prebiotic substance, components must not be broken down or absorbed in the small intestine. They act as a substrate to allow beneficial colonic bacteria to grow and consequently improve the ratio of beneficial colonic microflora.

Presumably the most widely recognised prebiotic substance used in food manufacture today is Hi-maize, a food ingredient with high levels of resistant starch; that is, a starch that resists digestion in the small intestine.

**Macronutrients**

Macronutrients are the essential nutrients that our bodies need in large amounts. These nutrients all supply the body with energy, promote growth and the repair of tissues, and regulate body processes. There are three macronutrients: carbohydrates, protein and fat.

**Absorption and use of macronutrients**

The absorption of nutrients occurs along the whole length of the small intestine, which is approximately 8 metres long. Food slowly passes along the small intestine, taking about 2–3 hours before it reaches the large intestine. This allows plenty of time for the absorption of nutrients to take place.

The walls of the small intestine are lined with thousands of tiny finger-like projections called villi. These villi create a large surface for the tiny units of each nutrient to pass through into either the bloodstream or the lymphatic system.

**Role of villi**

The surface of each villus is surrounded by a wall of single cells that allow nutrients to pass through. Within each villus is a network of blood capillaries, linking to veins and an artery. Glucose is absorbed through the blood capillaries and circulated throughout the bloodstream. In the centre of each villus is the lacteal. The lacteal is surrounded by tiny blood capillaries, which are connected to larger blood vessels. Fats are
absorbed into the lacteal, which is connected to the lymphatic system. When villi are damaged, nutrients cannot be absorbed properly. People with coeliac disease are intolerant to gluten and have trouble absorbing nutrients. The gluten irritates the villi, causing them to shrink and flatten so they are less effective in absorbing the nutrients.

**CARBOHYDRATES**

Carbohydrates contain the elements of carbon, hydrogen and oxygen. The complex metabolism of the body requires a source of energy in order to function, and carbohydrates are the body’s preferred fuel source. Foods that contain carbohydrates include breakfast cereals, rice, pasta, legumes, corn, potatoes, fruit, yoghurt, sugar, biscuits, cakes and lollies.

They contribute 16 kilojoules of energy per gram of carbohydrate. It is recommended that 45–65 per cent of our daily energy intake is derived from carbohydrates.

**Glycaemic index**

The glycaemic index or GI is based on how rapidly the carbohydrate is digested and absorbed into the bloodstream.

Carbohydrate foods are compared with glucose or white bread as a reference food and given a score of 100. The glycaemic index then compares foods that have the same amount of carbohydrate gram for gram.

Carbohydrates that break down quickly during digestion have a higher GI; that is, foods that release their glucose into the blood quickly, rate more than 70. Foods in this category include baked potatoes.

Carbohydrates that break down slowly, such as oats, release glucose gradually into the bloodstream. Low-GI foods prolong digestion because of their slow breakdown and will help give a sensation of feeling full or of satiety.

**Types of carbohydrates**

**Monosaccharides**

These single units of sugar are the base unit from which other carbohydrates are built. They have a sweet taste and are referred to as single sugars. Monosaccharides come in a number of forms. **Glucose** is the form of carbohydrate the body uses as energy and is found in onions, unripe potatoes and sweet fruits. **Fructose** is a simple sugar found in fruit, plant juices and honey. **Galactose** is found in the milk of mammals such as cows, goats and sheep.

**Disaccharides**

These are formed when two monosaccharides join together. These are often called double sugars and have a sweet taste and readily dissolve in water. **Sucrose** is formed from 1 unit of glucose plus 1 unit of fructose and is found in fruits, vegetables and cane sugar. **Lactose** is formed from 1 unit of glucose plus 1 unit of galactose and is found in milk. **Maltose** or malt sugar is formed from 2 units of glucose joined together and is formed when barley is malted in the brewing process.

**Polysaccharides**

Polysaccharides are carbohydrates made from many sugar units and are known as starches. These form during photosynthesis in plants from a varying number of monosaccharide units joined together in a chain. Polysaccharides are tasteless, readily dissolve in water and are converted to glucose during digestion. Starches are found mainly in cereals and starchy vegetables such as potatoes.
wholemeal breads and cereals, wheat and rice bran, fruit and vegetables with the skin on, nuts and seeds.

- **Resistant starch** resists digestion and promotes the growth of healthy bacteria. Although it is not considered a traditional fibre, it acts in a similar way. It resists digestion in the small intestine and is therefore valuable for bowel health. Foods containing resistant starch include baked beans, firm bananas, legumes, unprocessed cereals and grains. The resistant starch Hi-maize can also be added to some breads and breakfast foods.

### Absorption and use of carbohydrates

Carbohydrate is the body’s main supplier of energy. Sugars and starches are broken down to glucose during digestion. The glucose is absorbed into the blood capillaries and transported by the bloodstream to cells in other parts of the body.

The pancreas secretes a hormone called insulin, which helps the glucose to move from the bloodstream into the cells. Once inside the cell, the glucose is ‘burned’ along with oxygen to produce energy – glucose + oxygen → energy + CO₂ + water.

Any excess glucose is converted to glycogen and stored in the liver and muscle tissue. It can be used to supplement blood glucose levels during extended physical activity.

### Protein

The body requires protein throughout its life cycle, for growth and maintenance and repair of body cells. Protein is also required to produce enzymes, antibodies, haemoglobin and hormones.

Proteins are made up of simple units in chain formation called amino acids and contain the elements of carbon, oxygen, hydrogen and nitrogen. Amino acids are often referred to as the building blocks of life. The number and type of amino acids in the different types of protein chain vary considerably. The pattern of amino acids that form in the protein molecule determines the shape of that molecule and...
consequently its physical properties and the type of protein food. Each amino acid has its own chemical name and there are approximately 20 different types.

Eight amino acids cannot be produced by the body – these are called essential amino acids. The remainder can be produced by the body – these are called non-essential amino acids.

The main function of protein is for growth, maintenance and repair of body cells, but if there is too much protein in the diet it can be converted to kilojoules and used as energy, or if not used it will be stored as body fat. If there is insufficient carbohydrate and fat in the diet, protein can also be used as an energy supply. In this case it is referred to as a secondary source of energy. About 10 per cent of the body’s energy comes from protein.

The nutritional value of protein is measured by the quantity of the essential amino acids it provides.

Protein requirements

We require about 40 to 50 grams of protein daily. During periods of growth, during infancy, childhood, adolescence and pregnancy and lactation, greater amounts of protein are required in relation to body weight.

The amount of protein we require in our diet depends on our weight, age, stage of the life cycle and health.

### Pregnancy
- 1 gram per kilogram of body weight

### Lactation
- 1.1 gram per kilogram of body weight

### Infant 0–6 months
- 1.43 grams per kilogram of body weight

### Adolescence
- Boy – 0.94 grams per kilogram of body weight
- Girl – 0.87 grams per kilogram of body weight

### Adult women
- 0.75 grams per kilogram of body weight
- 70 + years – 0.94 grams per kilogram of body weight

### Adult men
- 0.84 grams per kilogram of body weight
- 70 + years – 0.94 grams per kilogram of body weight

Protein requirements across a human’s life span

### Types of proteins

**Complete proteins** come mainly from animal sources and contain all the essential amino acids. They are said to be of high biological value because they contain the amino acids required for growth and repair. Sources of complete proteins include meat, fish, eggs, cheese, milk and yoghurt. A small number of plant foods contain complete proteins, including soya bean products, quinoa and amaranth, a leafy green consumed in Asia and the Mediterranean.

**Incomplete proteins** come mainly from plant sources and lack one or more of the essential amino acids. They are said to be of low biological value because they do not contain all the essential amino acids required for growth and repair. Sources of these proteins include cereals such as wheat, oats and rye, pulses such as peas and beans, and lentils and nuts.

All the essential amino acids will be supplied in a diet that includes a range and variety of these proteins eaten together.
Absorption and use of protein

Proteins are broken down into amino acids during digestion. The amino acids are absorbed into the blood capillaries where they dissolve in the blood and are carried to the liver for storage.

These amino acids are the building blocks for protein synthesis for the creation of new tissue, cells and hair. Amino acids are also the precursors in the creation of body chemicals, such as enzymes and hormones.

FATS

Fats and oils have the same chemical elements as carbohydrates – carbon, hydrogen and oxygen – but the structure varies, so the foods have different properties. The elements are linked together to form fatty acids and glycerol. Fats and oils can be classified according to:

- their source – animal or vegetable
- the way in which they are distributed throughout foods – visible or invisible
- their chemical composition – saturated or unsaturated
- their state at room temperature – liquid or solid.

Dietary fats contain 37 kilojoules per gram and are considered to be very energy dense. Fats and oils also transport vitamins A, D, E and K around the body.

Types of fat

Saturated fats contain the maximum amount of hydrogen. A fatty acid is a long carbon chain with hydrogen atoms attached. When each carbon chain and oxygen atom has its full complement of hydrogen atoms, it is said to be saturated. Saturated fatty acids are predominantly present in fats that are solid at room temperature, and are mainly of animal origin. They tend to increase low-density lipoproteins (LDL), which increases the risk of heart disease. The main food sources of saturated fats include milk, butter and fats on meats. Coconut oil and palm oil are exceptions, because they are saturated fats of plant origin and are solid at room temperature.

Unsaturated fats can be monounsaturated or polyunsaturated fats. These fats do not contain the maximum amount of hydrogen, because each carbon chain does not have the full number of hydrogen atoms attached. Double bonds exist between the carbon atoms so the fatty acid is said to be unsaturated. Unsaturated fatty acids are mostly present in plant and vegetable oils. These fats can help to decrease cholesterol. Unsaturated fats are found mainly in peanut, olive, maize and canola oils, nuts, seeds and soy products.

Unsaturated

\[
\text{O} \quad \text{H} \\
\text{C} = \text{C} - \text{C} = \text{C} - \text{C} = \text{C} \\
\text{O} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H}
\]

In unsaturated fats, not all carbon atoms are saturated by hydrogen.

The chemical structure of unsaturated fats

Trans fats are created artificially through a process called hydrogenation. Liquid oil is converted to a solid fat with a maximum amount of the carbon chain and oxygen atoms filled with hydrogen. Like saturated fats, they are considered to be more harmful to health because they increase the level of bad (LDL) cholesterol and lower the level of high-density lipoproteins (HDL) or good cholesterol. Trans fats are thought to increase the risk of coronary heart disease. The main food sources of trans fats are pastries, cakes, biscuits, deep-fried foods and processed foods.

Absorption and use of fats

During digestion, fats are broken down to fatty acids and glycerol. These fatty acids and glycerol are absorbed into the lactic acid or inner section of the villi in the small intestine. In the lactic, they recombine to form fats, which mix with lymphatic fluid. They then move around the body in the lymphatic system, and join the blood circulation as insoluble fat. They are converted to soluble fat in the liver.
Activity 1.1
Trans fats, but not saturated fats, are the problem

Read the article below, then answer these questions:

1. Evaluate the validity of this news article. Consider the reliability of the sources of information used in the article, the context and presentation of evidence.

2. Outline the difference in the health risks associated with consuming saturated and trans fats.

3. What is the percentage of energy recommended by national guidelines for saturated fats and trans fats?

4. List the sources of saturated fats.

5. What ingredients are used to produce trans fats?

6. How are trans fats produced?

7. What foods are manufactured using these fats?

8. Explain why the researchers undertook this study.

9. Outline the key finding of the study in relation to trans fats and coronary heart disease (CHD).

10. Explain why it may be necessary to review the Dietary Guidelines for Australians in the future in light of this research.

Trans fats, but not saturated fats, are the problem

Saturated fats are not associated with an increased risk of death, heart disease, stroke, or type 2 diabetes, finds a Canadian study published in The British Medical Journal (BMJ) this week. However, the findings show that trans fats are associated with greater risk of death and coronary heart disease.

The study confirms previous suggestions that industrially produced trans fats might increase the risk of coronary heart disease and calls for a careful review of dietary guidelines for these nutrients.

Guidelines currently recommend that saturated fats are limited to less than 10%, and trans fats to less than 1% of energy to reduce risk of heart disease and stroke.

Saturated fats come mainly from animal products, such as butter, cow’s milk, meat, salmon and egg yolks, and some plant products such as chocolate and palm oils. Trans unsaturated fats (trans fats) are mainly produced industrially from plant oils (a process known as hydrogenation) for use in margarine, snack foods and packaged baked goods.

Contrary to prevailing dietary advice, a recent evidence review found no excess cardiovascular risk associated with intake of saturated fat. In contrast, research suggests that industrial trans fats may increase the risk of coronary heart disease.

To help clarify these controversies, researchers in Canada analysed the results of observational studies assessing the association between saturated and/or trans fats and health outcomes in adults.

The team found no clear association between higher intake of saturated fats and all cause mortality, coronary heart disease (CHD), cardiovascular disease (CVD), ischemic stroke or type 2 diabetes, but could not, with confidence, rule out increased risk for CHD death. The team did not find evidence that diets higher in saturated fat reduce cardiovascular risk.

However, consumption of industrial trans fats was associated with a 34% increase in all cause mortality, a 28% increased risk of CHD mortality, and a 21% increase in the risk of CHD.

AUSTRALIAN FOOD NEWS ausfoodnews.com.au, 12 August 2015
21 Briefly explain where the absorption of nutrients takes place during digestion and how long this process takes.

22 Explain how the structure of the villi assists the process of absorption of nutrients.

23 Describe what happens when the villi are damaged and how this impacts on the absorption process.

24 What contribution to energy do carbohydrates make?

25 Explain the term ‘glycaemic index’ and its impact on satiety.

26 Draw a diagram like the one below to summarise the key information about types of carbohydrates.

27 Outline why resistant starch is valuable in the digestive process.

28 Explain why protein is a valuable macronutrient for the body.

29 Complete the following table to demonstrate your understanding of types of proteins.

<table>
<thead>
<tr>
<th>PROTEIN TYPE</th>
<th>CHEMICAL MAKE-UP</th>
<th>FOOD SOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

30 Explain the chemical make-up of saturated fats. List four sources of saturated fats.
PREPARING FOR EXAMS

Applying knowledge
Draw a flow chart to demonstrate the passage of food through the digestive tract.

Analysing information
Analyse each of the following macronutrients and describe the way they are absorbed and used in the body.

- Carbohydrates
- Proteins
- Fats

Evaluating concepts
Rank the importance of hunger, appetite, satiety and the senses in determining an individual’s food intake. Justify your ranking.
OVERVIEW

• Updated for the new Food Studies VCE Study Design
• New, exciting dishes from around the world to complement existing, much-loved recipes
• Each recipe is accompanied by nutritional information to reflect the increased focus on enabling students to understand and own their food decisions
• Fully updated case studies and activities increase students’ understanding and awareness of the issues surrounding food supply and consumption
• Builds a foundation of learning for students to live better and pursue further training and employment in food-related industries.

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