4. Macronutrients: proteins, fats and carbohydrates ●
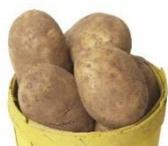
1) Fill in the gaps in the text below using the keywords to help.

Words to use:

| bowel | plant | starch | unsaturated | carbohydrates | large | saturated | sugars |

Macronutrients include proteins, fats and _____. They are called macronutrients

because people require them in _____ quantities to remain healthy. Proteins can be

found in both animal and _____ derived foods. Fats can be divided into two main

groups – ones that have single only bonds in the fatty acid chains are called _____,

and those which contain double or triple bonds are called _____. Carbohydrates

consist of _____, _____ and fibre. Fibre is necessary for the

proper functioning of the _____.

2) Identify whether the following foods given below are a main source of fat, protein or carbohydrate.

Cheese	Bread rolls	Butter	Avocados
Grapes	Pork chops	Pasta	Beans
Tuna (fish)	Hazelnuts	Cottage cheese	Doughnut
Carrots	Potatoes	Oranges	Eggs

3) Match up the functions below to each of the different macronutrients (*fats, carbohydrates* and *proteins*).

| | Help build hormones and enzymes |

| | Provide protection of the vital organs |

| | Provide the main source of energy |

Proteins

| | Dietary fibre supports bowel movements |

| | Help develop antibodies to fight bacteria and viruses and keep us healthy |

Fats

| | Increase satiety |

| | Building material of body cells such as muscle |

Carbohydrates

| | Help dissolve and absorb vitamins in the body |

| | Provide insulation from the cold to maintain body heat |

4) i) Using the keywords (provided), explain the difference between low biological value proteins and high biological value proteins.

| Amino acids | Quantity | Quality | Origin | Animal |

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ii) Describe what is meant by 'protein complementation' and give an example of your answer.

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iii)	Identify two different protein alternatives.

1.	....

2.	....

5)	i)	Mark sources of saturated (S) and unsaturated (US) fats by marking with either S or US.

Avocado	Cod	Salmon	Chocolate	Milk	Ham
Olive oil	Cheese	Butter	Nuts	Beef	Cream

ii)	What is the difference between monounsaturated fats and polyunsaturated fats?

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6)	Complete the table to explain the differences between the different types of carbohydrate.

| Type of carbohydrate		Description	Source of food they can be found in...
Starch	Polysaccharides		Wholegrain bread, brown rice
Sugars	Monosaccharides	Group of carbohydrates built from one molecule of sugar only	
	Disaccharides		
Dietary fibre			Wholegrain foods, fresh fruit and vegetables

7) Complete the table below to explain the effects of deficiency and excess of each of the macronutrients and identify the dietary reference values for males and females.

	Proteins	Fats	Carbohydrates
Effects of deficiency		• Loss of body mass • Vitamin deficiency • Hormonal disorders	
Effects of excess			• Overweight and obesity • Coronary heart disease • Hypertension • Type 2 diabetes • Tooth decay
Dietary reference value in % or grams for an average diet of 2,000 kcal	10–15% (50–75 g)		

Exam-style Question

Fat can be found in a variety of food products.
Name **one** animal source and **one** plant source of visible and non-visible fats.
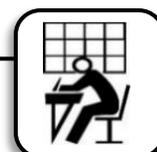
(4 marks)

Extension Task

Design and/or modify a recipe that meets the following criteria:
• is suitable for a vegetarian
• has reduced fat content
• and has high fibre content

When creating your recipe, try to apply various skills. For example:
• knife skills – to cut meat, fish or protein alternative products
• use of various cooking and preparation methods
• use of starch to set a mixture

Use the Extension Task worksheet to help you.

	What ingredients and cooking methods I CAN use	What ingredients and cooking methods I CANNOT use
Vegetarian		
Reduced fat content		
High fibre content		

Name of my dish: ....

Ingredients of my dish and why I chose them:

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My recipe – how to prepare my dish:

4. Macronutrients: proteins, fats and carbohydrates ■

1) Using the keywords to help, describe what is meant by 'macronutrients'.

Words to use:

bowel	plant	starch	unsaturated
carbohydrates	large	saturated	sugars

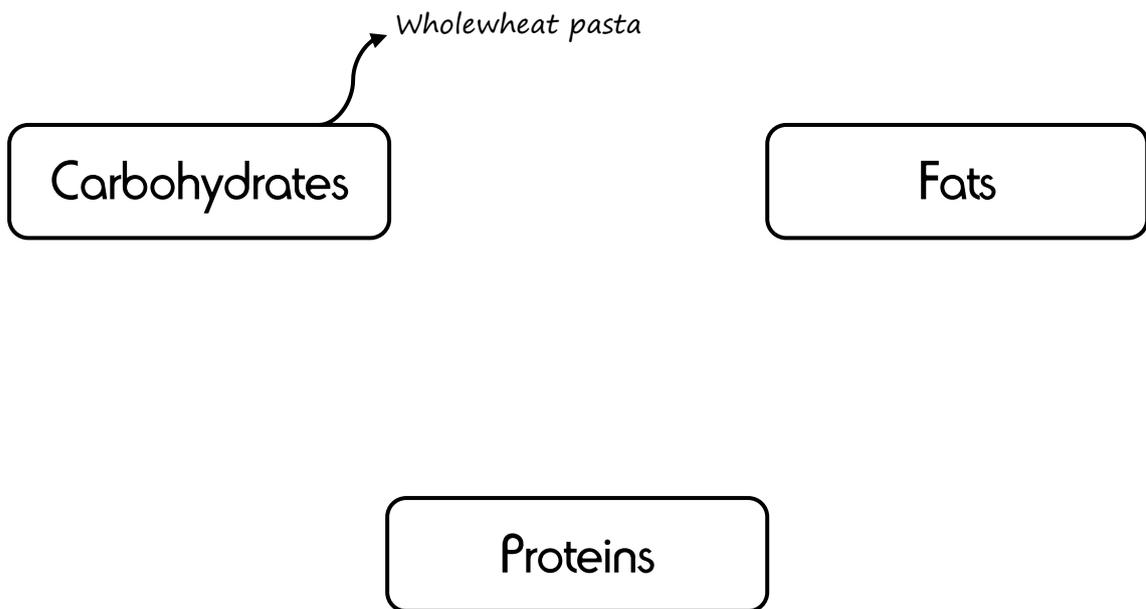...

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2) On each of the spider diagrams below, identify as many foods as you can that provide a main source of fat, protein or carbohydrate.

Wholewheat pasta

Carbohydrates

Fats

Proteins

3) Identify the functions of each macronutrient (*fats, carbohydrates* and *proteins*).

Fats	Proteins	Carbohydrates

4) i) Explain the difference between low biological value proteins and high biological value proteins.

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ii) Describe what is meant by 'protein complementation' and give an example of your answer.

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iii) Identify four different protein alternatives.

1. ....

2. ....

3. ....

4. ....

5) There are two types of fats that can be consumed in the diet. Describe the different types of fat that can be found in the diet and give examples in your answers.

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6) Complete the table to explain the differences between the different types of carbohydrate.

Type of carbohydrate		Description	Source of food they can be found in
Starch	Polysaccharides		
Sugars	Monosaccharides		
	Disaccharides		
Dietary fibre			

7) Macronutrients should be consumed in relative proportions as too much or too little can have negative health consequences. Provide the Dietary Reference Values for an average diet of 2,000 kcal and explain the health consequences of a deficiency and an excess of each macronutrient.

Proteins: ....

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Fats: ....

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Carbohydrates: ....

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────── Exam-style Question ──────

A school chef has bought some roast beef, salmon steaks and chickpeas to prepare dinner. Compare the contributions that beef, salmon and chickpeas can make to the nutritional requirements of teenagers.

(6 marks)

────── Extension Task ──────

Your task is to design and cook a three-course meal for a group of people who are on a low fat, high fibre diet. Some of the individuals are vegetarian, so remember to take account of their dietary needs. While making your meal, see if you can identify any of the following processes or use any of the following skills:

Process:
- How acids denature/coagulate proteins

Skills:
- Knife skills – to cut protein sources
- Use alternative methods of cooking fat sources – grilling/baking
- Use starch to set a mixture

4. Macronutrients: proteins, fats and carbohydrates

1) ●■ Higher ability to provide similar answer to lower-ability worksheet

Macronutrients include proteins, fats and **carbohydrates**. They are called macronutrients because people require them in **large** quantities to remain healthy. Proteins can be found in both animal and **plant** derived foods. Fats can be divided into two main groups – ones that have single only bonds in the fatty acid chains are called **saturated**, and those which contain double or triple bonds are called **unsaturated**. Carbohydrates consist of **starch**, **sugars** and fibre. Fibre is necessary for the proper functioning of the **bowel**.

2) ●■ Higher ability to provide similar sources to ones given below, on their spider diagrams

Fats	Cheese, butter, avocados, pork chops, doughnut
Proteins	Hazelnuts (nuts and seeds), tuna (fish), eggs, pork chops, cottage cheese
Carbohydrates	Grapes (berries), pasta, carrots, potatoes, oranges, bread rolls, beans

3) ●■ Higher ability to provide similar functions

	Functions
Fats	• Provide protection of the vital organs • Help dissolve and absorb vitamins in the body • Provide insulation from the cold to maintain body heat
Proteins	• Help build hormones and enzymes • Help develop antibodies to fight bacteria and viruses and keep us healthy • Building material of body cells such as muscle
Carbohydrates	• Provide the main source of energy • Increase satiety • Dietary fibre supports bowel movements

4) i) ●■
   - Low biological value (LBV) proteins and high biological value (HBV) proteins differ in the quality and quantity of amino acids they contain.
   - LBV proteins don't contain enough essential amino acids or contain them in a low **quantity** and are usually from plant sources.
   - HBV proteins contain all the essential amino acids and are usually those of **animal origin**.

   ii) ●■
   - Protein complementation is a process in which low biological value proteins are combined together to form a high biological value protein meal.
   - An example of this is beans on toast, when lysine-low bread is balanced by lysine-high beans.

   iii) ●■ Lower ability to provide two alternatives, higher ability to provide four alternatives
   Protein alternatives include:
   - Soybeans and all soy-derived products such as tofu, tempeh, soy chunks
   - Quinoa
   - Quorn™ (mycoprotein)
   - Various legume-based products such as hummus (which is made from chickpeas and sesame seeds)

5) i) ●

Avocado (US)	Cod (US)	Salmon (US)	Chocolate (S)	Milk (S)	Ham (S)
Olive Oil (US)	Cheese (S)	Butter (S)	Nuts (US)	Beef (S)	Cream (S)

   ii) ●
   - Monounsaturated fats have only one double bond in the fatty acid chains while polyunsaturated fats have more than two of them.
   - Monounsaturated fats begin to solidify at low temperatures while polyunsaturated fats become liquid.

5) ■
   - Depending on the chemical structure, we can differentiate two kinds of fats: saturated and unsaturated.
   - Unsaturated fats may be further split into monounsaturated and polyunsaturated fats.
   - In saturated fats all the chemical bonds in fatty acid chains are single. An example of this is lard.
   - In monounsaturated fats there is one double bond in the fatty acid chain, and in the polyunsaturated fats there is more than one double bond in the fatty acid chain. An example of an unsaturated fat is olive oil.
   - The other way of categorising fats is by dividing them into visible and non-visible fats.
   - Visible fats include lard, suet, butter, cream and the white visible fatty tissue in meats such as bacon.
   - Non-visible fats include fats which are present in food products, but can't really be seen, such as in avocados, olives, milk and cheese, meat and cold cuts (other than the white visible part), fish, etc.

6) ●■

Type of carbohydrate		Description	Source of food they can be found in
Starch	Polysaccharides	Is built from many sugar molecules bound together into long chains; can be broken down by enzymes in the human digestive tract. Also known as complex carbohydrates.	Wholegrains, such as wholewheat flour, brown rice, etc. contain starch and dextrin. Bread contains starch and dextrin.
Sugars	Monosaccharides	Group of sugars built from one molecule of sugar only	Fruit and vegetables contain glucose and fructose. Honey contains a mixture of various mono- and disaccharides.
	Disaccharides	Group of sugars built from two sugar molecules	Table sugar contains sucrose, honey contains a mixture of various mono- and disaccharides, milk contains lactose. Cereals such as barley contain maltose.
Dietary fibre		Is built from many sugar molecules bound together into long chains; cannot be broken down in the human digestive tract	Wholegrains and vegetables contain insoluble fibre, i.e. cellulose. Fruit, vegetables and seeds such as flaxseed contain soluble fibre, such as pectin. Cereals, such as oats, are rich in soluble and insoluble fibre.

7) ●■ Higher ability to provide similar information with explanations.

	Proteins	Fats	Carbohydrates
Effects of deficiency	• **Swelling** – proteins are responsible for maintaining the so-called oncotic blood pressure, so if there is too little protein, the water will be retained in the body and this will cause swelling. • **Hormonal disorders** – many hormones are made of protein, so if there is not enough, the hormones could not be built • **Growth arrest** – protein is necessary to build all cells around the body, so if there is no protein, the body cannot build new cells and cannot grow or develop. • **Kwashiorkor** – this is the effect of long-term, chronic protein deficiency. Lack of protein will lead to retention of water in the intestines, and this will cause them to swell, so the stomach will look big and swollen.	• **Loss of body mass** – fat is used to build cell walls and forms fatty tissue around the body to insulate it and store energy for later. If there is not enough fat, the body will use the reserve and in effect you will lose weight. • **Vitamin deficiency** – fat is a solvent of many vitamins, so not eating enough fat means that you are also eating too few vitamins, and this may cause further health problems. • **Hormonal disorders** – many hormones require fat to be built, so lack of fat means that they could not be built.	• **Hypoglycaemia** – too few carbohydrates means that there will be too little sugar available in the bloodstream. • **Weight loss** – cutting down on carbohydrates means that your body will use other sources of energy such as fatty tissue. In extreme cases it may also break down muscles to make energy, and in effect you will lose weight. • **Loss of consciousness** – glucose is the only substance which can be used by the brain as a source of energy. If there is not enough glucose, you may faint or lose consciousness (this is also common in people treated with insulin, who use too much of it).
Effects of excess	• **Depression, low mood** • **Kidney and liver disorders** –protein is processed in the liver which breaks it down into urea, so too much protein will overburden the liver. The kidneys filter the blood to form urine; if there is too much protein they will be overburdened and won't filter the blood properly, which might cause them to fail.	• **Overweight and obesity** – excess fat is stored in the body as fatty tissue. This accumulates around the internal organs, and in the hips, arms and thighs, so eating too much fat will lead to weight gain. • **Coronary heart disease** – fat, especially saturated fat, increases levels of LDL cholesterol in the blood. This can bond with calcium and accumulate in blood vessels as plaque. The plaque may build up and block the blood vessels around the body and in the heart, and may increase the risk of a heart attack or stroke. • **Hypertension** – excessive consumption of fat, especially saturated fat, causes plaque to accumulate in blood vessels. The more plaque, the less space available in the vessels for blood, so the blood pressure will rise, as the amount of blood remains stable. • **Type 2 diabetes** – obesity increases the risk of type 2 diabetes. Type 2 diabetes occurs more often in obese people than in people with a healthy body weight.	• **Overweight and obesity** – excess sugar will be turned into fatty tissue by the body and stored, so you will gain weight. • **Coronary heart disease** – a diet high in sugar increases blood cholesterol levels, and this may lead to plaque accumulation in the blood vessels leading to atherosclerosis, CHD and hypertension. • **Type 2 diabetes** – if you're eating too many carbohydrates (especially sugars), they are absorbed into the bloodstream rapidly, which causes a peak in blood glucose levels. To lower this, the pancreas needs to produce more and more insulin, and eventually may fail. There will be no more insulin to lower blood sugar levels and these will stay permanently high, leading to damage of the nerves and body organs. • **Tooth decay** – sugar is a food for bacteria living in your mouth; if you are eating too much of it, bacteria will reproduce more rapidly and damage the enamel on your teeth.
Dietary reference value in % or grams for an average diet of 2,000 kcal	10–15% (50–75 g)	25–35% (55–77 g)	Around 50% 250 g

Exam-style Question

1) ● 4 marks
- **Animal source of visible fat:** bacon, lard, suet, butter
- **Animal source of non-visible fat:** milk, cheese, meat, egg
- **Plant source of visible fat:** olive oil, sunflower oil, coconut oil, cocoa butter
- **Plant source of non-visible fat:** seeds (e.g. pumpkin seeds), nuts (e.g. almonds, hazelnuts), peanuts, avocado, olives

Other suitable answers may be accepted.

1) ■ 6 marks

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated, showing a clear understanding and comparison of the contribution that beef, salmon and chickpeas can make to the nutritional requirements of teenagers. Specialist terms are used appropriately and correctly.	**5–6 marks**
There is a line of reasoning presented with some structure that is, for the most part, relevant and supported by some evidence showing an understanding and comparison of the contribution that beef, salmon and chickpeas can make to the nutritional requirements of teenagers. Some specialist terms are used, although these may not always be used appropriately..	**3–4 marks**
The information is basic and communicated in an unstructured way. The candidate shows limited understanding and only some comparison of the contribution that beef, salmon and chickpeas can make to the nutritional requirements of teenagers. Answer may be ambiguous or disorganised.	**1–2 marks**
Student doesn't provide any relevant answer.	**0 marks**

Indicative content:

Specific requirements of teenagers:
- complete (high biological value) protein to support growth and development of tissues around the body
- complex carbohydrates to provide energy throughout the day
- fats to provide energy and to help absorb vitamins from food
- calcium and phosphorus to support growth of bones and teeth
- iron to help prevent anaemia (in girls)
- vitamins A, C and E to boost immune system and prevent disease
- vitamin B12 to prevent anaemia
- essential fatty acids to support brain development
- fluoride to help build tooth enamel and prevent tooth decay

Beef contributes:
- high biological value protein
- haem iron which is absorbed better than non-haem iron, so can be used by the body more easily
- vitamins A and B12
- some calcium and phosphorus
- saturated and unsaturated fats

Salmon contributes:
- high biological value protein
- haem iron
- vitamins A and B12
- calcium and phosphorus
- essential fatty acids
- some fluoride

Chickpeas contribute:
- low biological value protein, so may not be sufficient on their own for teenagers
- some carbohydrates (including dietary fibre)
- non-haem iron
- some vitamins C and E

Conclusion:
- salmon may be the most suitable food for teenagers as it meets almost all of their requirements
- beef should be the food of second choice as it lacks essential fatty acids and may be too high in saturated fats
- chickpeas must be eaten in combination with other foods to provide high biological value protein

Other correct responses may be accepted.