FACTFILE:
GCSE DAS BIOLOGY UNIT 1.3

Rewarding Learning

Food Tests

Learning Outcomes

1.3.1 recall the colour changes for the following reagents, Benedicts, iodine solution, Biuret and ethanol.

Reagent	Initial Colour	End colour for positive test
Benedicts	Blue	Brick red precipitate
Iodine solution	Yellow-brown	Blue-black
Biuret	Blue	Lilac-purple
Ethanol	Colourless	White emulsion

1.3.2 investigate food samples using food tests, including:

- reducing sugar (Benedict's);
- starch (iodine solution);
- amino acid or protein (Biuret); and
- fats (ethanol).

1.3.3 explain the importance of the following biological molecules:

- carbohydrates, made up of simple carbohydrates (sugars, glucose and lactose) as sources of energy and storage, complex carbohydrates (cellulose, starch and glycogen);
- fats/**lipids**, including oils, made up of fatty acids and glycerol, as sources of energy and storage;
- proteins, made up of amino acids, as structural and functional molecules in cells;

Practical 1.3 investigate the energy content of food by burning food samples.

Food tests

When testing samples of food for the food groups they contain, scientists use a range of biochemical tests. The solutions added to the samples are called reagents. Reagents are substances that cause a chemical reaction when they are added to the sample. The chemical reaction usually causes a visible colour change or the formation of a precipitate or emulsion. In this unit you need to be able to identify the positive result seen when food is tested for reducing sugars, starch, protein/amino acids and lipids (fats).

Testing for reducing sugars using Benedict's solution.

Step one: Place a sample of the food into a boiling tube with some water and add a few drops of Benedict's solution.

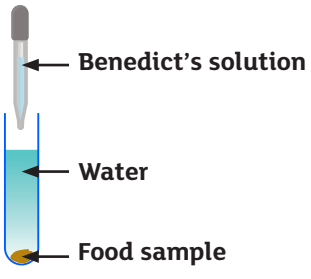

Figure 1

Step two: Place the boiling tube into a water bath and heat.

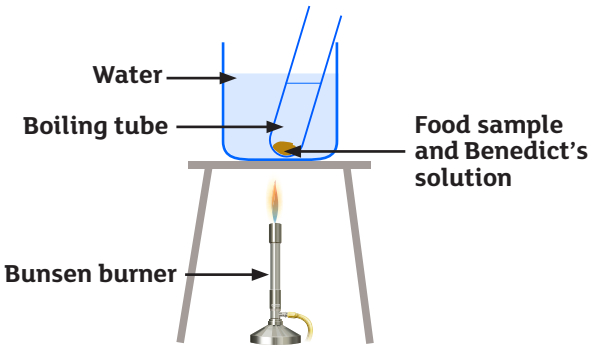

Figure 2

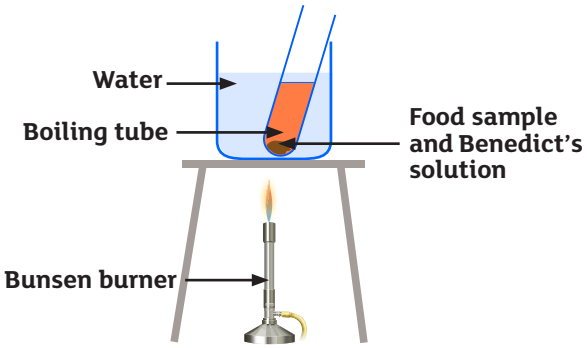

Figure 3

Result: A colour change from blue to green to orange to brick red will occur depending on the amount of sugar present. Reducing sugars include glucose and lactose.

Testing for starch using iodine solution

Step One: Add a few drops of iodine solution to the food sample.

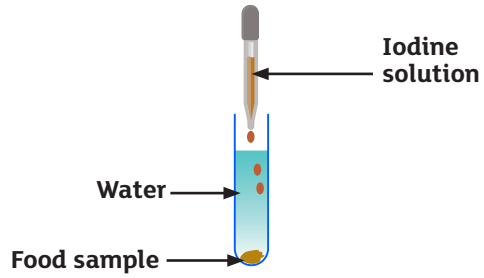

Figure 4

Figure 5

Result: the iodine turns from yellow/brown to blue/black if starch is present.

Testing for protein/amino acids using Biuret

**Note: Biuret is a solution of sodium hydroxide and copper sulphate*

Step one: Add a few drops of Biuret to the food sample and shake.

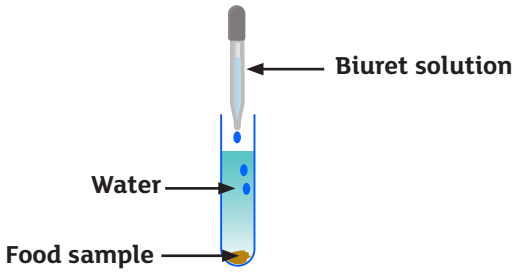

Figure 6

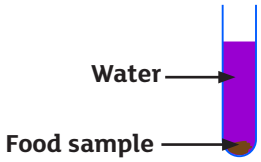

Figure 7

Result: The biuret turns from blue to purple

Testing for lipids using ethanol

Step one: Add the ethanol to the food sample and mix

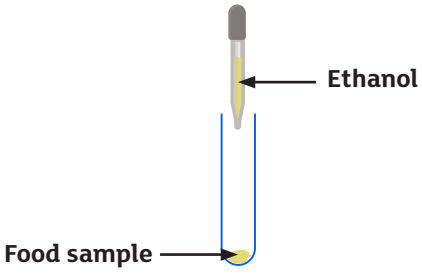

Figure 8

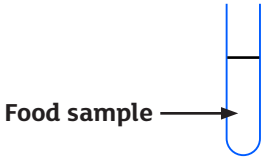

Figure 9

Result: the ethanol turns from clear to form a white emulsion.

Find the nutrition and food words in the word search

W	F	J	D	S	X	S	Y	B	S	D	I	P	I	L
J	J	D	N	S	W	E	S	O	L	U	L	L	E	C
S	E	T	A	R	D	Y	H	O	B	R	A	C	B	R
O	P	N	U	T	R	I	T	I	O	N	K	E	E	D
F	A	T	B	I	U	R	E	T	J	U	N	D	Q	E
M	N	I	D	J	I	M	U	J	H	E	U	Y	S	L
B	I	O	I	O	H	G	D	O	D	C	A	O	O	M
G	E	D	C	L	V	C	H	I	I	N	T	N	J	O
L	T	I	A	Z	J	R	C	N	E	C	A	L	S	Y
U	O	N	O	Z	I	T	G	G	A	H	Z	T	G	H
C	R	E	N	O	S	S	O	L	T	O	A	R	U	F
O	P	S	I	Z	U	C	U	E	G	R	E	C	J	R
S	C	H	M	G	Y	V	V	H	C	N	P	H	O	C
E	Y	H	A	L	H	M	H	H	E	Y	J	Z	V	J
J	Y	R	G	Z	T	A	T	L	X	V	A	S	E	T

Source: generated using http://www.word-search-world.griddler.co.uk/Word-Search-Generator.aspx

amino acid
benedicts
biuret
carbohydrates
cellulose
energy
ethanol
fat
glucose
glycogen
iodine
lactose
lipids
nutrition
protein
starch

1. The table shows the results of food tests carried out on a biscuit.

Test reagent	Reagent colour at start	Result of food test
Benedict's	Blue	Positive
Ethanol	Clear	Positive
Biuret	Blue	Negative
Iodine	Yellow-brown	Positive

Look at the table

Use the information in the table to draw conclusions about the types of food in the biscuit.

Describe the colour change for each food test.

In this question you will be assessed on your written communication skills, including the use of specialist scientific terms.

_____

_____

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_____ [6]

Source: CCEA GCSE Biology, Unit 1 Higher Tier, 2015 Question 4.

2 (a) Complete the table by

- adding **two** column headings,
- naming **one** reagent,
- describing **three** colour changes.

	Colour before food test		
Iodine	Yellow/brown		[1]
Benedict's		Brick red precipitate	[1]
Biuret	Blue		[1]
	Clear	White emulsion	[1]

[2]

Three of the reagents were used to carry out tests on three foods A, B and C.

The results are shown in the table below.
□ 5 positive result □ 5 negative result

Food tested	**Reagent**		
	Iodine	**Benedict's**	**Biuret**
A	□	□	□
B	□	□	□
C	□	□	□

(b) (i) Which of the foods tested contain starch?

_____ [1]

(ii) Which of the foods tested contains **both** sugar and protein?

_____ [1]

Source: CCEA GCSE Biology, Unit 1 Foundation Tier 2012 Question 5

Biological Molecules

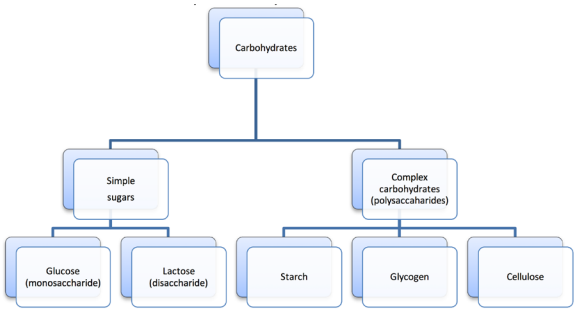
In this unit you will study the three main groups of biological molecules that are important in our diet.

- Carbohydrates
- Lipids (fats)
- Protein

These molecules are described as organic molecules because they are made mainly of carbon (C). It is important to understand how the structure of these molecules is related to their functions within cells. We will look at each group in turn.

Carbohydrates

Carbohydrates is the group name for a number of simple sugars and more complex molecules, which are made up of the atoms carbon, hydrogen and oxygen. The diagram below shows the molecules you will study in this section.



Simple Sugars

Simple sugars can be made up of one or two units. When there is only one unit present they are described as being monosaccharides, or example glucose, when there are two units they are described as being disaccharides, for example lactose.

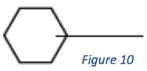


Figure 10

Glucose is made up of a single unit it is called a monosaccharide

Figure 11

Lactose is made up of two units it is called a disaccharide

Simple sugars are the main source of energy for respiration (the process by which plants and animals make the energy they need to function). Glucose is the main respiratory substrate in animals. Carbohydrates and sugars that are consumed in our diet are broken down are absorbed

across the wall of the ileum into the blood. Those sugars that are needed immediately are carried to respiring cells and tissues to make energy. The chemical equation below shows how glucose if respired.

glucose + oxygen ⟶ water + carbon dioxide + energy

Lactose is a simple sugar found in milk. It is made up of two molecules, one of glucose and one of another sugar called galactose. This molecule is broken down by the enzyme lactase and the glucose and galactose will be used by the cells.

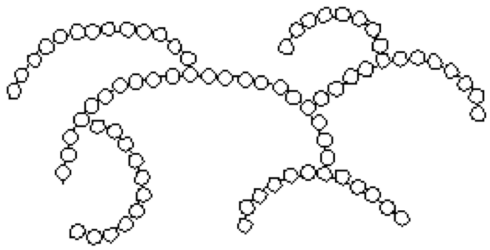
The body does not use all the sugar that is absorbed into the blood straight away. The sugar is soluble and will affect the movement of substances into and out of cells which can be harmful to the organism. Therefore, the excess sugar in plants and animals must be stored or used structurally. The complex carbohydrates we will study are all made from many units of glucose joined in a particular way, they are described as polysaccharides.

Polysaccharides are made of many units joined together

Figure 12

Complex Carbohydrates

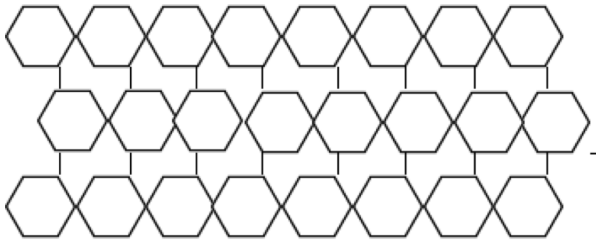
Starch is a storage product made by plants. It is made up of many units of glucose joined together. The shape of the molecule makes it important as a storage molecule as it can easily be broken down to release glucose when the plant needs it for respiration. The large molecule is insoluble and therefore will not affect the movement of substances into and out of cells. When animals consume starch the starch is broken down in the digestive tract to release the glucose. Therefore, foods like potatoes and pasta that are high in starch are a good energy source for humans.



Starch is made up of many units of glucose
The branches make it easy to break down

Figure 13

Cellulose is a complex carbohydrate that has a structural role in plants. It is found in plant cell walls that give the plant support and help it to stay upright. This complex molecule is also made up of many units of glucose but they are arranged in a more linear pattern to give the molecule more strength.



Cellulose is made up or rows of glucose joined together to give it strength

Figure 14

Glycogen is a storage product found in animals. When animals consume carbohydrates they are broken down into simple sugars and absorbed into the blood. The excess glucose is converted into glycogen and stored in the liver. The glycogen has many many branches so that it can quickly and easily be broken down to release glucose for respiration.

Lipids

Lipids are also made of carbon, hydrogen and oxygen. Lipids are made up of two main units; glycerol and fatty acids. Lipids are used for insulation and as an energy store.

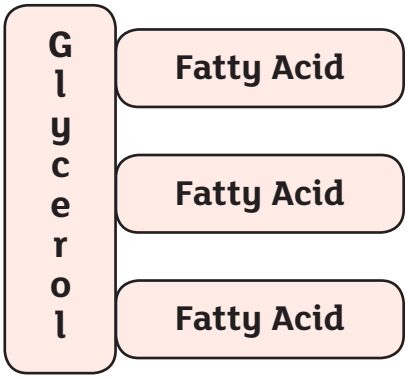


Figure 15

The fatty acids have a long chain made up of carbon and hydrogen. If the bonds in the chain are all single bonds the lipid is said to be saturated. If there is a double bond in the chain, the lipid is said to be unsaturated. Polyunsaturated fats have several double bonds in the chain.

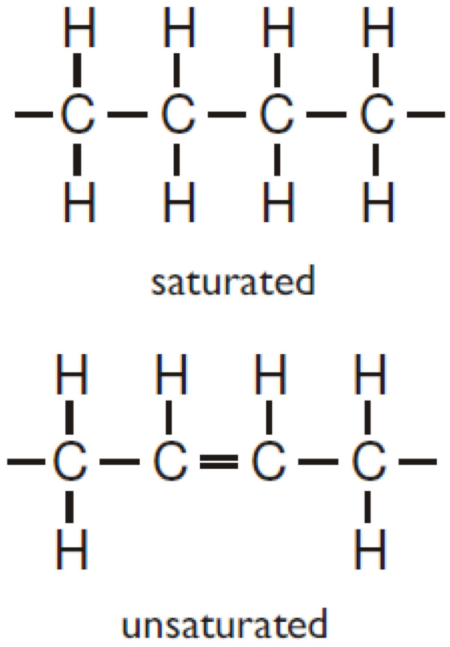


Figure 16

Saturated fats have a high melting point and are usually solid like butter or lard. Unsaturated fats have a lower melting point and are usually oils like vegetable oil.

Proteins and Amino acids

Amino acids are single units that join together to make a protein (also called a polypeptide). Amino acids are made of carbon, hydrogen, oxygen and nitrogen (they sometimes contain sulfur). There are 20 known different amino acids that all have a slightly different structure. The order of amino acids in a protein is dictated by the bases in our DNA.

Figure 17

Once the sequence of amino acids is in place the long chain will fold into a 3D shape. The shape of the protein will determine its function.

Proteins are used for growth and repair and have many functions in the cells such as enzymes, hormones, carrier molecules for transport among many other functions.

Test Your Knowledge

1. Identify the three elements common to carbohydrates, lipids and protein.
2. Name the branched carbohydrate used as a storage product in animals.
3. Explain how the structure of cellulose makes it suitable as a structural molecule in cell walls.
4. Identify the two molecules in a lipid.
5. What is meant by the term saturated fatty acid?
6. Amino acids contain carbon, hydrogen and oxygen, name one other element found in all amino acids.