MY REVISION NOTES

HODDER EDUCATION

WJEC/Eduqas

AS/A-level Year 1

BIOLOGY

- Plan and organise your revision
- Reinforce skills and understanding
- Practise exam-style questions

Dan Foulder

MY REVISION NOTES
WJEC/Eduqas AS/A-level Year 1
BIOLOGY

Boost

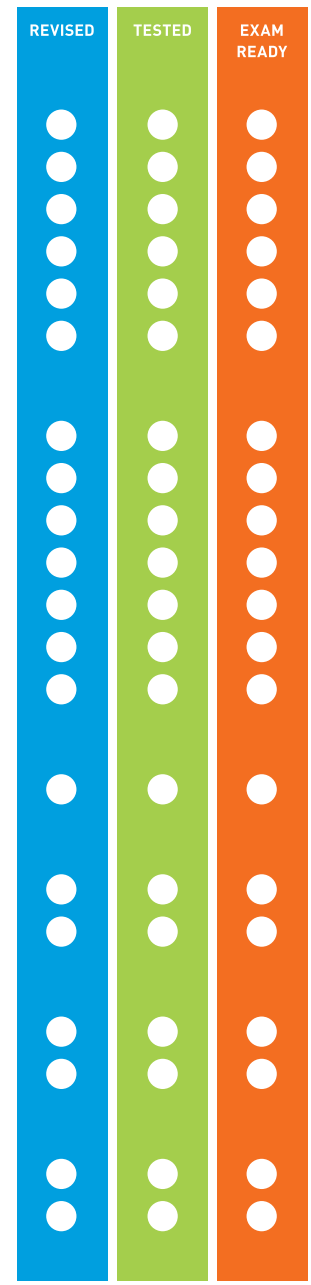
HODDER EDUCATION
LEARN MORE

My Revision Planner

Countdown to my exams

Exam breakdown

Unit 1 Basic biochemistry and cell organisation



1 Chemical elements and biological compounds

2 Cell structure and organisation

3 Cell membranes and transport

4 Biological reactions and enzymes

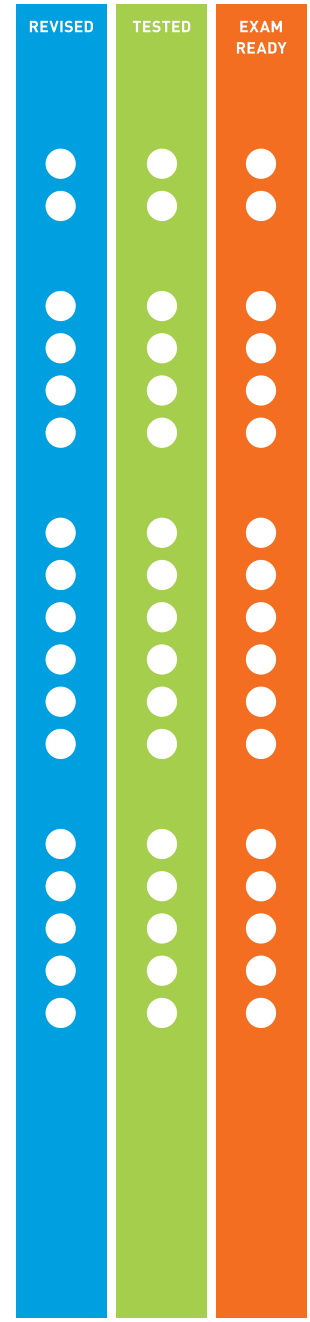
5 Nucleic acids and their functions

6 Genetic information

Check your answers at **www.hoddereducation.co.uk/myrevisionnotes**

Unit 2 Biodiversity and physiology of body systems

Answers and quick quizzes online at
www.hoddereducation.co.uk/myrevisionnotes



Countdown to my exams

6–8 weeks to go

- Start by looking at the specification — make sure you know exactly what material you need to revise and the style of the examination. Use the revision planner on pages 4 and 5 to familiarise yourself with the topics.
- Organise your notes, making sure you have covered everything on the specification. The revision planner will help you to group your notes into topics.
- Work out a realistic revision plan that will allow you time for relaxation. Set aside days and times for all the subjects that you need to study, and stick to your timetable.
- Set yourself sensible targets. Break your revision down into focused sessions of around 40 minutes, divided by breaks. These Revision Notes organise the basic facts into short, memorable sections to make revising easier.

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2–6 weeks to go

- Read through the relevant sections of this book and refer to the exam tips, summaries and key terms. Tick off the topics as you feel confident about them. Highlight those topics you find difficult and look at them again in detail.
- Test your understanding of each topic by working through the 'Now test yourself' questions in the book. Look up the answers online at **www.hoddereducation.co.uk/myrevisionnotes**.
- Make a note of any problem areas as you revise, and ask your teacher to go over these in class.
- Look at past papers. They are one of the best ways to revise and practise your exam skills. Write or prepare planned answers to the exam practice questions provided in this book. Check your answers online and try out the extra quick quizzes at **www.hoddereducation.co.uk/myrevisionnotes**
- Use the revision activities to try out different revision methods. For example, you can make notes using mind maps, spider diagrams or flash cards.
- Track your progress using the revision planner and give yourself a reward when you have achieved your target.

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One week to go

- Try to fit in at least one more timed practice of an entire past paper and seek feedback from your teacher, comparing your work closely with the mark scheme.
- Check the revision planner to make sure you haven't missed out any topics. Brush up on any areas of difficulty by talking them over with a friend or getting help from your teacher.
- Attend any revision classes put on by your teacher. Remember, he or she is an expert at preparing people for examinations.

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The day before the examination

- Flick through these Revision Notes for useful reminders, for example the exam tips, summaries and key terms.
- Check the time and place of your examination.
- Make sure you have everything you need — extra pens and pencils, tissues, a watch, bottled water, sweets.
- Allow some time to relax and have an early night to ensure you are fresh and alert for the examinations.

REVISED

My exams

AS Biology Paper 1

Date:.....

Time: .....

Location: .....

AS Biology Paper 2

Date:.....

Time: .....

Location: .....

Exam breakdown

This book covers the AS/Year 1 A-level qualification for WJEC Biology and AS Eduqas Biology.

WJEC

Unit	Unit title	Marks	Unit weighting as a percentage of the AS qualification
AS Unit 1	Basic biochemistry and cell organisation	80	50% (20% of the full A-level)
AS Unit 2	Biodiversity and physiology of body systems	80	50% (20% of the full A-level)

Eduqas

Component	Component title	Marks	Component weighting as a percentage of the AS qualification
Component 1	Basic biochemistry and cell organisation	75	50% of AS
Component 2	Biodiversity and physiology of body systems	75	50% of AS

Assessment details

WJEC AS

The AS qualification comprises two units, AS Unit 1 and AS Unit 2. AS Units 1 and 2 are assessed by written examination, each lasting 90 minutes and worth 80 marks. Each paper has a range of compulsory short and longer structured questions and one extended response, which is worth 9 marks.

Eduqas AS

The AS qualification is achieved from two written examinations, each lasting 90 minutes and worth 75 marks. These papers cover Components 1 and 2 of the specification. Each paper has a range of short and longer structured compulsory questions.

Overview

The concepts in Unit 1/Component 1 are fundamental and underpin the whole of A-level biology. Your understanding of some of the principles in Unit 1/Component 1 may be re-examined in later units.

Each topic has specified practical work that you must complete and that you could be questioned on in the exam. This often provides opportunities for examiners to assess your mathematical skills as well as your practical skills. For example, when studying aspects of mammalian physiology, such as the kidney and the nervous system, you may make observations of microscope slides of various tissues and organs. Examiners may use photomicrographs or drawings of these tissues and organs and ask questions relating the visible structures to their functions. They may also ask you to calculate the actual size of structures in the image, or to calculate the magnification of the image, both of which you should have done during your first A-level year.

1 Chemical elements and biological compounds

Students often find this topic challenging, but it is important to persevere, and questions on this topic can earn you some fairly straightforward marks in the exam. The learning in this topic is also fundamental to many of the topics you will study at AS and A-level. In this topic, we will first look at the biological importance of water and some key inorganic ions. We then move on to the three main classes of biological molecule you need to study: carbohydrates, lipids and proteins.

Water is essential to all life on Earth

The properties of water arise from the chemical structure of the water molecule. Water molecules consist of two hydrogen atoms covalently bonded to an oxygen atom.

Exam tip

Some students confuse the terms atom and molecule when describing water. Make sure you are not making simple errors like this in your answers.

Water is a polar molecule because it has a slightly uneven distribution of charge

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The hydrogen atoms of the water molecule are slightly positively charged, while the oxygen atom is slightly negatively charged; therefore the molecule is a dipole/polar.

Polar molecule
A molecule that has an uneven distribution of charge.

This slight uneven distribution of charge allows **hydrogen bonds** to form between the hydrogen atom of one water molecule and the oxygen atom of another water molecule.

The hydrogen bonds create a force known as cohesion, which 'sticks' the water molecules together. Hydrogen bonding between water molecules is shown in Figure 1.1.

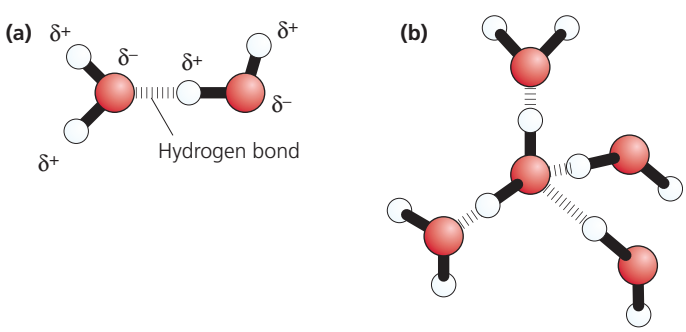

Figure 1.1 (a) The charges on water molecules; (b) a cluster of water molecules

The cohesion forces are responsible for the following:

- The high **surface tension** of water and the formation of a 'skin' at the point where the water meets the air. This skin allows some organisms, such as pond skaters and basilisks, to literally walk on water.
- The transport of long columns of water up the xylem in the stem of plants as part of the transpiration stream.

Making links

The cohesion forces between the water molecules allow water to be transported in the transpiration stream from roots, up the xylem in the stem and to the leaves. Water molecules are lost by transpiration from the stomata. This puts tension on the stream of water molecules, pulling them up the xylem. This is the cohesion–tension theory.

Water is a universal solvent: it dissolves a wide variety of solutes

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The ability of water to dissolve many different solutes is an important property because:

- it means that chemical reactions can occur in solution
- it makes transport inside living organisms much easier – solutes such as glucose are able to dissolve, for example in the blood, and then be carried around an organism

Making links

Water is also a metabolite in many reactions. It is a product in respiration and a reactant in photosynthesis.

Water has a very high specific heat capacity

REVISED

Having a high specific heat capacity means that it takes a large amount of energy to raise the temperature of a body of water. This is important in cells because it means that a relatively large amount of heat is required to raise a cell's temperature. Therefore, the cell is able to maintain a relatively stable internal temperature.

The high specific heat capacity of water is also important in bodies of water such as lakes and ponds. It means that the water provides a relatively stable environment for aquatic animals.

Water has a high latent heat of evaporation

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Having a high latent heat of evaporation means that a relatively large amount of energy is required to turn water from a liquid into a gas. This is important for living organisms because the evaporation of water (e.g. during sweating) takes energy away from the skin and causes a cooling effect.

Exam tip

Students often get confused between the high latent heat of water and high specific heat capacity. Make sure you are clear about the difference between these two terms, particularly in long-answer or QER questions.

Water is transparent and has a relatively low density when in a solid state

REVISED

Solid water has a lower density than liquid water. Therefore, solid ice floats on top of liquid water. The ice provides an insulating layer on the top of a body of water. The liquid water beneath the solid ice has a higher temperature than the air above it, allowing aquatic organisms to survive even if the water at the surface has frozen. Water's transparency is also important for aquatic

organisms. It allows light to travel through it, which means that aquatic organisms such as plants and algae are able to photosynthesise.

Now test yourself TESTED

1 Explain the biological importance of cohesion forces between water molecules.
2 Explain the advantage of water's high latent heat to organisms.
3 What property of water means that cells have a relatively consistent internal temperature?
4 Explain why water is known as a universal solvent.

Exam tip

If you are talking about the advantages to living organisms of water being transparent, make sure you are specific. Answers such as 'lets light get to plants' or 'allows fish to see' will not earn you any marks.

Inorganic ions have a range of functions in living organisms

The key inorganic ions are:

- calcium, Ca^{2+} – used to strengthen bones and teeth
- iron, Fe^{2+} – a component of haemoglobin, which is used to bind to oxygen in red blood cells
- magnesium, Mg^{2+} – used to form the green, photosynthetic pigment chlorophyll
- phosphate, PO_4^{3-} – used to form phospholipids, which are a component of cell plasma membranes

Making links

Inorganic ions, such as the ones listed here, are charged and so cannot pass through the phospholipid bilayer. They have to move through carrier or channel proteins by facilitated diffusion or active transport.

Exam tip

Make sure that you answer exam questions precisely. In a recent exam a number of students stated that magnesium is in chloroplasts, which was an insufficiently detailed answer. For the mark you need to say that magnesium ions are found in chlorophyll. In another exam question, just writing 'calcium makes up teeth' was not awarded the mark. Students had to say that calcium *strengthens* the teeth.

Monomer molecules join together to make polymers

Carbohydrates and proteins form **polymers**. A polymer is a large molecule made up of repeating units called **monomers**. Polymers are formed in polymerisation reactions, where monomers join together to make a polymer.

Condensation reactions are the polymerisation reactions that join the monomers together to form a polymer. A small molecule, usually water, is also produced during condensation reactions. **Hydrolysis** reactions do the opposite and break the bonds in a polymer using water, releasing the monomers.

Monomer A single molecule that is the repeating unit of a polymer.

Polymer A large molecule made up of repeating units called monomers.

Condensation reaction A reaction in which two molecules are combined to form one molecule, usually with the loss of a small molecule (e.g. water).

Hydrolysis reaction A reaction in which water is chemically inserted in order to break a bond.

Carbohydrates contain carbon, hydrogen and oxygen

Carbohydrates are extremely important chemicals in biology. They range from simple sugars like glucose to large, complex polymers such as chitin.

It is important to know the number of bonds that atoms of carbon, hydrogen and oxygen form in a molecule. This information will allow you to check any structural diagrams you have drawn to make sure they are correct.

Remember that:

- carbon atoms form four bonds
- hydrogen forms one bond
- oxygen atoms form two bonds

Monosaccharides are the basic unit of a carbohydrate

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All monosaccharides have the general formula $C_nH_{2n}O_n$. Therefore, a monosaccharide has the same number of carbon atoms as oxygen atoms and twice as many hydrogen atoms as carbon atoms.

Monosaccharides can be classified by the number of carbon atoms they contain:

- three carbon atoms – triose sugars
- five carbon atoms – pentose sugars (e.g. deoxyribose found in DNA)
- six carbon atoms – hexose sugars (e.g. glucose)

We will focus on the hexose sugars, and in particular glucose. Other hexose sugars include fructose and galactose.

Glucose is the monomer for many different polysaccharides. It is also used in respiration to produce ATP (the universal chemical energy currency used in cells). Glucose has two isomers:

- alpha glucose
- beta glucose

Isomers are molecules that have the same chemical formula but a different structure. The two isomers of glucose are shown in Figure 1.2. Glucose can be drawn in a linear form, but it is nearly always shown as a ring structure, as in Figure 1.2.

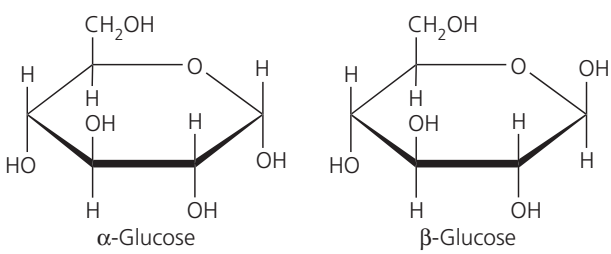

Figure 1.2 Isomers of glucose

The difference between alpha and beta glucose is the different arrangement of the H and OH (hydroxyl group) on carbon 1.

Disaccharides are formed from two monosaccharides

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The formation of a disaccharide is a condensation reaction. In this condensation reaction a molecule of water is produced when the bond is formed. This bond is a 1–4 glycosidic bond. This is because it forms between carbon atom 1 and carbon atom 4.

When two glucose molecules are joined by a 1–4 glycosidic bond the disaccharide maltose is formed. This reaction is shown in Figure 1.3.

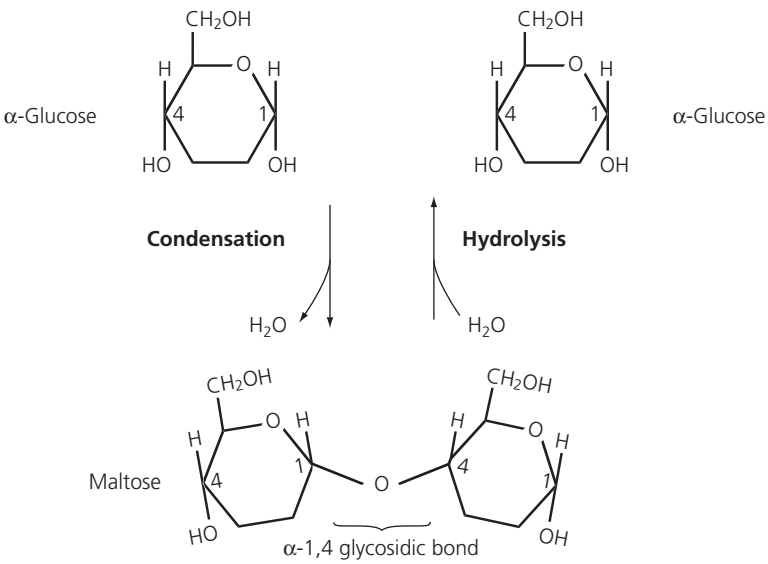

Figure 1.3 The formation and hydrolysis of maltose

A hydrolysis reaction can be used to break the chemical bond formed in a condensation reaction. In a hydrolysis reaction the bond is broken by the chemical insertion of water. When the glycosidic bond in maltose is broken in a hydrolysis reaction, two molecules of glucose will be formed.

Table 1.1 shows the disaccharides formed when different monosaccharides are joined by condensation reactions.

Table 1.1

Monosaccharides	Disaccharide
glucose + glucose	maltose
glucose + fructose	sucrose
glucose + galactose	lactose

Exam tip

In recent exams the majority of students have answered questions on simpler biochemistry very well. This means that it is important to make sure you have revised all this thoroughly, to ensure you are scoring these relatively straightforward marks.

Polysaccharides are formed from three or more monosaccharides

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A polysaccharide is a polymer formed from monosaccharides during condensation reactions. Monosaccharides are the monomers. Most polysaccharides contain thousands of monomers.

- Polysaccharides generally either have a structural function or are used for storage of glucose.
- The large size of polysaccharides means they are insoluble. This is important for them to be able to carry out their functions.
- Polysaccharides are osmotically inactive. This means that they can be stored in cells without any detrimental osmotic effects, such as lowering the water potential in the cell, causing water to move in by osmosis.
- In storage polysaccharides it is important that glucose can be removed easily from the molecules so that it can be used in respiration.

Polysaccharide Three or more monosaccharides linked by glycosidic bonds.

The two main storage polysaccharides are starch and glycogen

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- **Starch** is a polymer made up of alpha glucose monomers. Starch has two components, amylose and amylopectin. It is found in plants.
- Amylose is a chain of glucose monomers joined by 1–4 glycosidic bonds and formed into a helix. The structure of amylose is shown in Figure 1.4.
- Amylopectin has both 1–4 and 1–6 glycosidic bonds. Having two different bonds means amylopectin has a branched structure. The structure of amylopectin is shown in Figure 1.5.

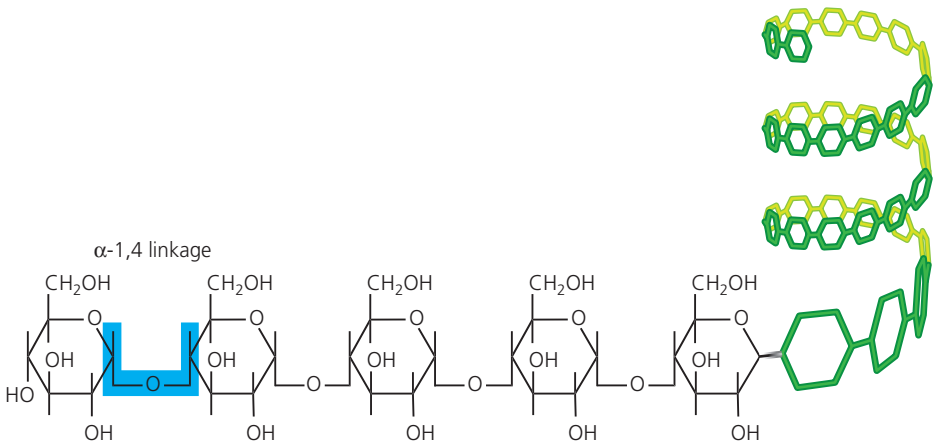

Figure 1.4 The structure of amylose

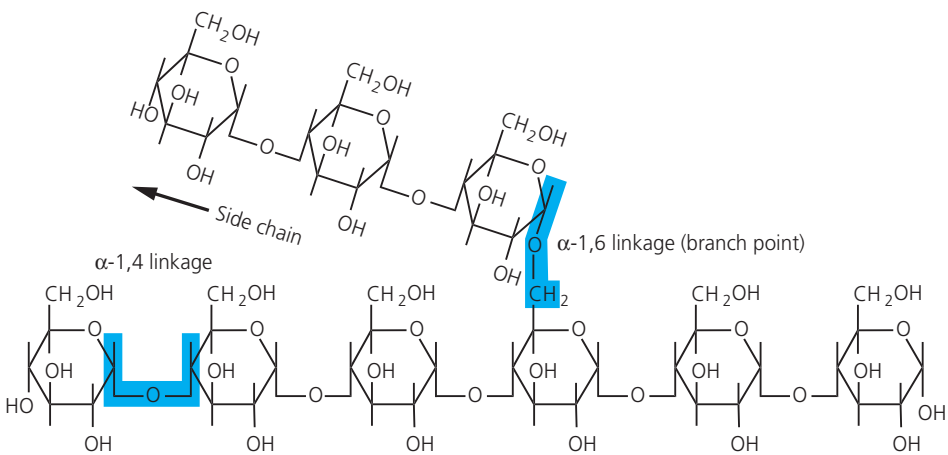

Figure 1.5 The structure of branched polysaccharides: amylopectin and glycogen

- **Glycogen** is a polymer made up of alpha glucose monomers. Like amylopectin it has both 1–4 and 1–6 glycosidic bonds, so has a branched structure. Glycogen is used to store glucose in animals. It is found in muscle cells.

Cellulose is a polymer made up of beta glucose monomers

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- Cellulose makes up the cell walls of plant cells.
- The beta glucose monomers are joined by 1–4 glycosidic bonds and are arranged into long, straight chains.
- Each beta glucose molecule is rotated 180 degrees from the previous molecule in the chain. This enables hydrogen bonds to form between the OH groups in adjacent chains. The structure of cellulose is shown in Figure 1.6.

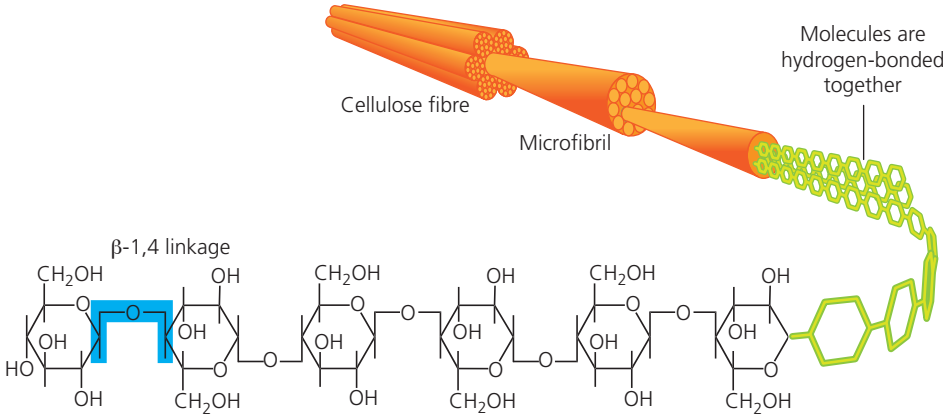

Figure 1.6 The structure of cellulose

Many cellulose chains form a microfibril and many microfibrils form a cellulose fibre. Cellulose fibres make up the cell walls of plants. Even though individual hydrogen bonds are weak, the large number of hydrogen bonds in cellulose gives it high tensile strength. This makes the cell wall strong and rigid and prevents the cell from bursting.

Chitin is a mucopolysaccharide

REVISED

- Chitin has a similar structure to cellulose.
- It is made up of chains of beta glucose monomers with acetylamine side-chains.
- Instead of an OH group on the second carbon of each beta glucose molecule, chitin has an acetylamine group.
- Chitin is strong and lightweight and is used to form the exoskeletons of insects and the cell walls of fungi.

Exam tip

It is easy to get confused over which monomer makes up which polysaccharide. Remember, storage polysaccharides have alpha glucose monomers while structural polysaccharides have beta glucose monomers.

Practical skills

Biochemical tests for carbohydrates

You need to know the biochemical tests used to identify carbohydrates.

Starch test

- Add several drops of iodine.
- If the solution turns blue/black then starch is present.

Reducing sugar test

- Add Benedict's reagent to the unknown sample.
- Boil the solution.
- If a reducing sugar is present, a brick-red precipitate will form.

All monosaccharides are reducing sugars and so are some disaccharides, such as maltose.

Non-reducing sugar test

If the reducing sugar test returns a negative result, a further test can be carried out to determine whether a non-reducing sugar (such as sucrose) is present in the sample. A non-reducing sugar can be identified by first hydrolysing the glycosidic bond in the molecule, forming two monosaccharides. These monosaccharides will then produce a positive result when boiled with Benedict's reagent. The glycosidic bond is hydrolysed by heating the non-reducing sugar with acid:

- Heat the solution with acid, such as hydrochloric acid.
- Neutralise by adding an alkali, such as sodium hydroxide.
- Add Benedict's reagent to the unknown sample.
- Boil the solution.

If a non-reducing sugar was present in the original sample a brick-red precipitate will form.

Exam tip

Students often fail to fully revise the biochemical tests, but they do come up in exams. For each test make sure you know:

- the name of the test
- how to carry out the test
- what the positive results and negative results are

Now test yourself TESTED

5 What are the products of the hydrolysis of maltose?

6 Which polysaccharide is used for storage in animals?

7 Explain why it is important that polysaccharides that have a structural function are insoluble.

8 Describe how chitin differs from other polysaccharides.

Lipids are made up of the same elements as carbohydrates

Lipids and carbohydrates consist of the elements carbon, hydrogen and oxygen. Unlike carbohydrates, lipids are not made up of monomers that link together to form polymers. Lipids consist of two different molecules: glycerol and fatty acids. Glycerol is found in all lipids (Figure 1.7).

Fatty acids consist of a methyl group, a hydrocarbon chain and a carboxyl group

REVISED

The hydrocarbon chain of a fatty acid contains an even number of carbon atoms – between 14 and 22. Fatty acids can be either saturated or unsaturated. Saturated fatty acids have no carbon-to-carbon double bonds in the hydrocarbon chain. Unsaturated fatty acids do have carbon-to-carbon double bonds within the hydrocarbon chain. Examples of saturated and unsaturated fatty acids are shown in Figure 1.8.

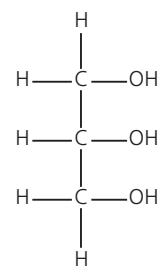

Figure 1.7 Glycerol

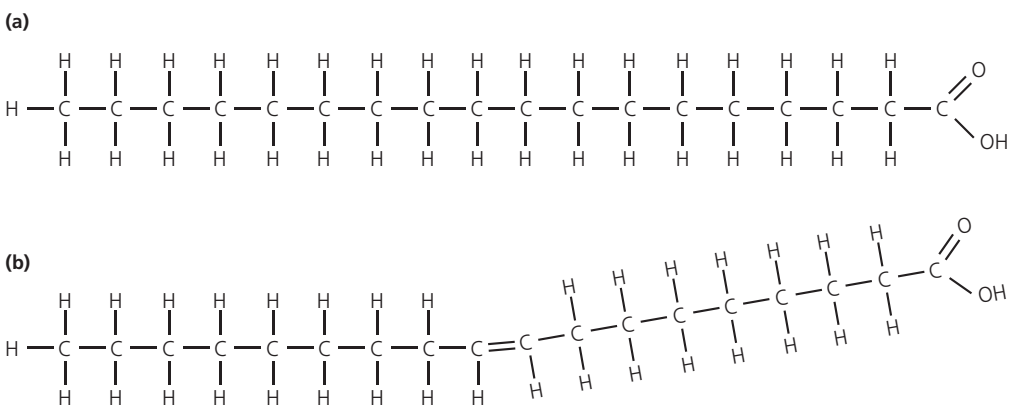

Figure 1.8 (a) A saturated fatty acid; (b) an unsaturated fatty acid with one double bond

Saturated fatty acids are found in animal fat and unsaturated fatty acids are found in plant oils.

Three fatty acids combine with one glycerol molecule to form a **triglyceride**. Each fatty acid is linked to the glycerol by an ester bond. The ester bonds are formed by condensation reactions. As there are three ester bonds in a triglyceride, they will be formed by three condensation reactions. The properties of a triglyceride depend on the fatty acids they contain.

Triglyceride Three fatty acids joined to glycerol by ester bonds.

In this reaction each OH group on the glycerol molecule loses a hydrogen atom while the carboxyl group of the fatty acid loses an OH, to form three molecules of water. This reaction and the hydrolysis reaction that breaks the ester bonds are shown in Figure 1.9.

In Figure 1.9 the fatty acid's hydrocarbon chain is drawn in a simplified form as a zigzag line.

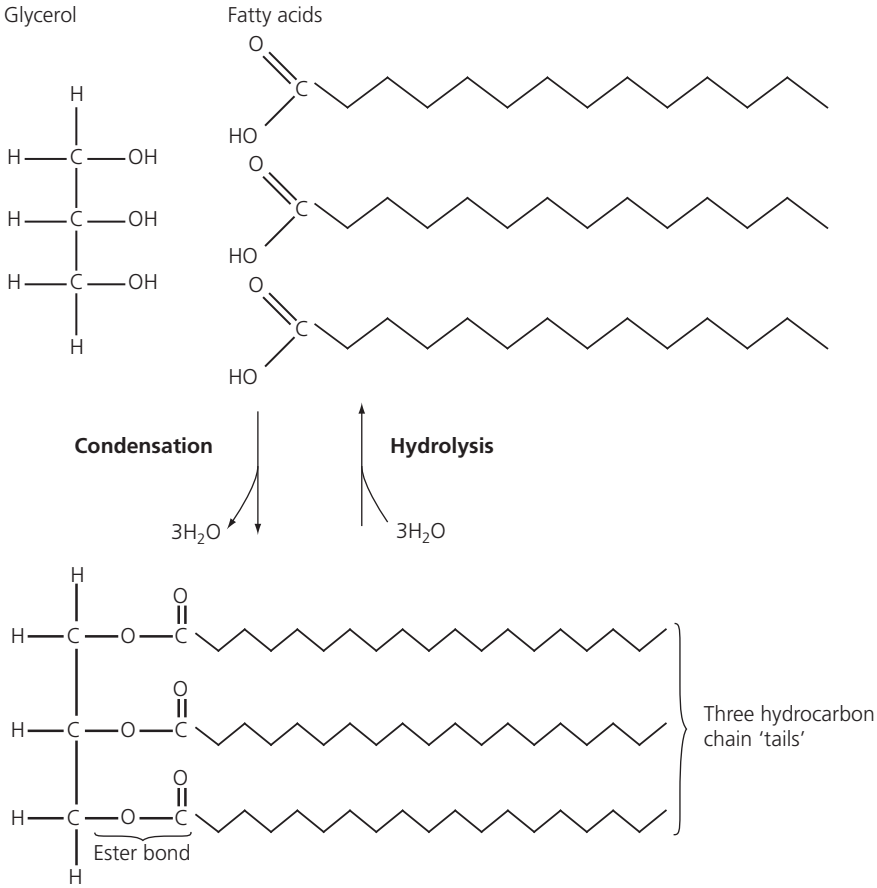

Figure 1.9 The formation and hydrolysis of a triglyceride

Exam tip

You will not be asked to draw out the whole triglyceride structure, but you could be asked to show how the fatty acids bond with the glycerol, so make sure you learn this structure. It is also important to remember that the water molecules formed are made from the OH group of the fatty acid and the H from the glycerol.

Phospholipids are formed from two fatty acids, a phosphate group and a glycerol molecule

REVISED

Phospholipids are formed from two fatty acids and a phosphate group combined with a molecule of glycerol. The structure of phospholipids means the following:

- The head (the glycerol and phosphate) of the molecule is polar and therefore hydrophilic. This means that it is attracted water.
- The tail (the two fatty acids) of the molecule is hydrophobic. This property is important in the formation of cell membranes.

Figure 1.10 shows the structure of a phospholipid.

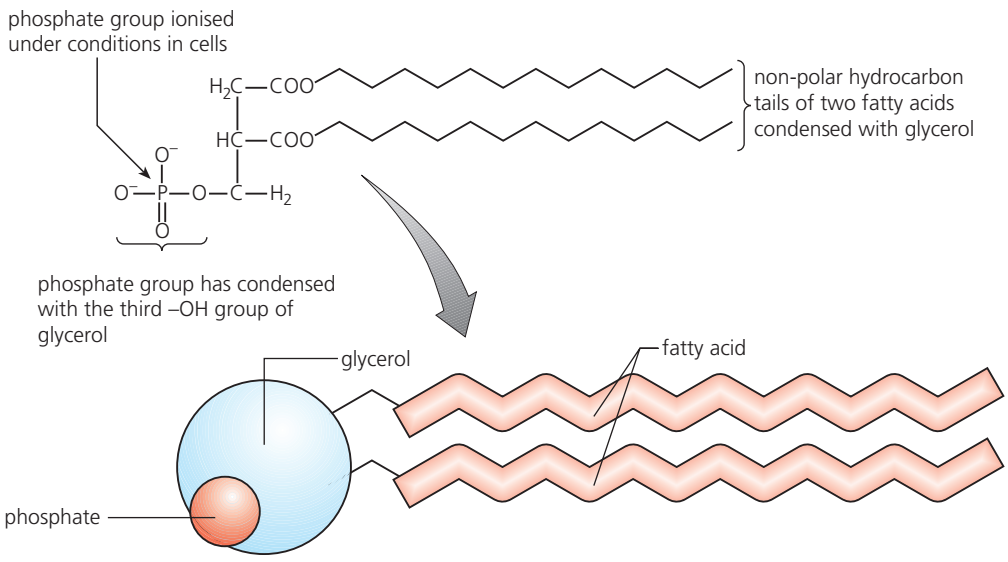

Figure 1.10 A phospholipid

Check your answers at www.hoddereducation.co.uk/myrevisionnotes

Lipids have a number of functions in living organisms

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Lipids can be used in various ways:

- energy storage – a lipid stores twice as much energy as the same mass of carbohydrate; this makes it an efficient store of energy; lipids are used in seeds to store energy
- protection of delicate organs
- thermal insulation
- buoyancy in aquatic organisms
- a source of metabolic water for organisms that live in arid environments, for example camels

Lipids are insoluble in water, but soluble in organic solvents such as acetone and ethanol.

Saturated fats are found in animals and are a contributory factor in heart disease in humans

REVISED

A high intake of saturated fats raises the levels of low-density lipoprotein (LDL) cholesterol in the blood. This can then lead to an increase in the risk of atheroma. An atheroma is a build-up of abnormal material in the wall of the artery. This can lead to the artery becoming blocked. If this happens in the coronary arteries that supply the cardiac muscles, it can lead to the muscles dying and a heart attack (myocardial infarction) occurring.

Saturated fats are solid at room temperature. Unsaturated oils are liquid at room temperature, and are found in plants.

Practical skills

Test for lipids

Lipids can be identified using the emulsion test:

- Ethanol is added to the sample and shaken thoroughly.
- Distilled water is then added. If the solution remains colourless, then the test is negative.
- If a layer of cloudy white suspension forms then the test is positive and lipids are present in the sample.

Now test yourself

TESTED

9 Name the molecules joined by ester bonds.

10 Explain how the structure of a triglyceride differs from the structure of a phospholipid.

11 Explain why lipids are more efficient energy storage molecules than carbohydrates.

12 Explain how a saturated fatty acid differs from an unsaturated fatty acid.

Proteins are an incredibly varied class of biological molecules

Proteins are polymers of amino acids

REVISED

Proteins are made up of the elements carbon, hydrogen, oxygen and nitrogen. They also sometimes contain **sulfur**.

Proteins are polypeptides. A polypeptide is a polymer of **amino acids**. Figure 1.11 shows the structure of an amino acid.

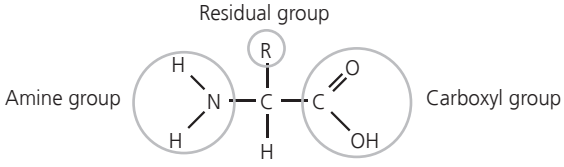


Figure 1.11 The general structure of an amino acid

Exam tip

In a recent exam question few students correctly linked the requirement for sulfur to the production of proteins.

MY **REVISION** NOTES

WJEC/Eduqas AS/A-level Year 1

BIOLOGY

Target exam success with *My Revision Notes*. Our updated approach to revision will help you learn, practise and apply your skills and understanding. Coverage of key content from Year 1 is combined with practical study tips and effective revision strategies alongside online quick quizzes, creating a guide you can rely on to build both knowledge and confidence.

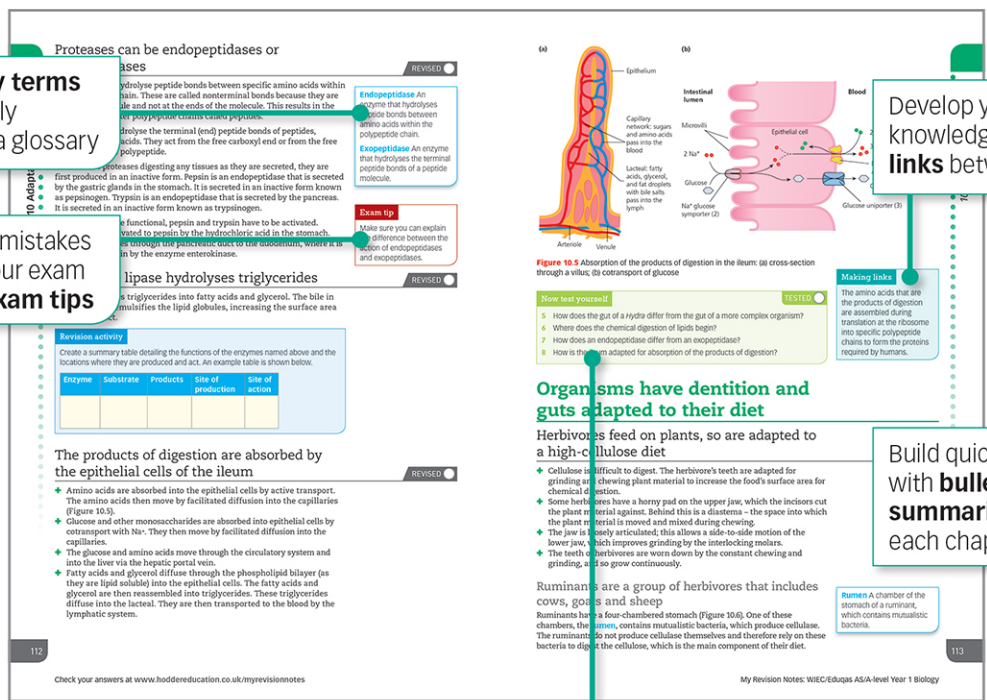
***My Revision Notes: WJEC/Eduqas AS/A-level Year 1 Biology* will help you:**

Develop your scientific skills; **exemplar standard procedures** ensure you can confidently approach practical work

Plan and manage your revision with our **topic-by-topic planner** and exam breakdown introduction

Understand **key terms** with user-friendly definitions and a glossary

Avoid common mistakes and enhance your exam answers with **exam tips**



Develop your subject knowledge by **making links** between topics

Build quick recall with **bullet-pointed summaries** at the end of each chapter

Improve **maths skills** using worked examples to guide you through calculations, followed by practice questions

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