MY REVISION NOTES

HODDER EDUCATION

WJEC/Eduqas

A-level Year 2

BIOLOGY

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

MY REVISION NOTES WJEC/Eduqas A-level Year 2 BIOLOGY

Dan Foulder

Boost

HODDER EDUCATION
LEARN MORE

My Revision Planner

8 The nervous system

53 Mammals can respond to external and internal stimuli
55 Simple organisms such as *Hydra* have nerve nets
55 Motor neurones comprise a cell body and an axon
58 Neurones are linked to each other by synapses

Unit 4 Variation, inheritance and options

9 Sexual reproduction in humans

61 Reproduction in humans relies on internal fertilisation
62 The production of gametes is known as gametogenesis
63 Fertilisation occurs in the oviducts
65 The menstrual cycle is regulated by hormones
65 Pregnancy is regulated by hormones

10 Sexual reproduction in plants

68 Angiosperms carry out sexual reproduction
70 Pollen grains are produced in the anther by meiosis
70 The ovary of the female plant produces the ovule
71 Pollination is followed by internal fertilisation within the ovaries
71 Seeds can be monocotyledonous or dicotyledonous

11 Inheritance

74 Alleles are different forms of the same gene
74 The first genetic investigations were carried out by Mendel
78 A sex-linked condition is controlled by an allele on the X or Y chromosome
79 Alleles on the same chromosome will be inherited together
80 A mutation is a random change in the DNA of an organism
82 Other factors can influence gene expression

12 Variation and evolution

83 Genetic and environmental factors produce variation
86 The gene pool is all the alleles for all the genes in a population
86 The frequency of the alleles of one gene in a population will be constant
87 Evolution is the change in organisms over many generations
88 Mutations lead to genetic variation in a population
88 Allele frequencies can also change due to chance
89 Speciation occurs when two groups of organisms can no longer produce fertile offspring

13 Application of reproduction and genetics

92 The genome is an organism's genetic instructions
93 Genetic fingerprints can be used in forensic investigations
94 The PCR is important in the application of genetics
95 Genetic engineering utilises recombinant DNA technology
96 Bacteria can be modified to produce useful substances
97 Plants can be modified to give desirable characteristics

REVISED | TESTED | EXAM READY

REVISED	TESTED	EXAM READY

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 4–6 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.

REVISED

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.

REVISED

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.

REVISED

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

A-level Biology Paper 1

Date:..

Time: ....

Location: ....

A-level Biology Paper 2

Date:..

Time: ....

Location: ....

A-level Biology Paper 3

Date:..

Time: ....

Location: ....

Exam breakdown

This book covers the A-level Year 2 qualifications for WJEC and Eduqas Biology.

Assessment details

WJEC

A2

A2 Units 3 and 4 are examined by written papers. Each lasts 2 hours and is worth 90 marks. Each unit accounts for 25% of the total A-level marks. Unit 3 is examined in a range of short and longer structured questions and one extended response. Unit 4 has two sections: Section A also has a range of short and longer structured questions and one extended response while for Section B you must choose one option from three – Immunology and disease, Human musculoskeletal anatomy or Neurobiology and behaviour. This will be a structured question.

Unit 5 comprises an experimental task (worth 20 marks) and a practical analysis task (worth 30 marks). This unit is worth 10% of the total A-level marks.

Eduqas

A-level

The three A-level examination papers are each 2 hours long and each worth 100 marks. Each paper has a range of short and longer structured compulsory questions. Assessment of core concepts will be included. Component 3 has two sections. Section A is worth 80 marks. Section B covers the optional component and is worth 20 marks.

The practical endorsement assesses practical competency. It is reported separately and does not contribute to the final grade.

Overview

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

The A-level biology course is more demanding than AS. You have to develop a deeper understanding of biological concepts and demonstrate a greater ability to apply your knowledge and understanding of biology. The A-level course also has a greater synoptic element – you need to start piecing together the topics you have studied so far and try to see the links between them.

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 Importance of ATP

ATP is synthesised in chloroplasts and mitochondria

The internal membranes of chloroplasts and mitochondria have stalked particles that contain the enzyme **ATP synthase**. When protons (H^+) flow through this enzyme, ATP is synthesised from ADP and Pi. Protons flow down their concentration gradient. This concentration gradient is known as an electrochemical gradient and the process is known as **chemiosmosis**.

ATP synthase An enzyme that synthesises ATP from ADP + Pi.

Chemiosmosis Movement of ions across a semipermeable membrane down an electrochemical gradient.

Making links

Because protons are charged they are unable to pass through the hydrophobic tails of the phospholipid bilayer.

The electrochemical gradient is maintained by proton pumps on the inner membranes. The proton pumps are fuelled by high-energy electrons, which are passed along an electron transport chain. The electron transport chain is made up of an alternate arrangement of electron and proton pumps.

In mitochondria ATP synthase is found on the inner mitochondrial membrane

REVISED

In the mitochondria protons are pumped from the matrix into the intermembrane space, maintaining a high concentration there. They then flow down their concentration gradient into the matrix, where there is a lower concentration of protons, through ATP synthase channels, producing ATP.

In chloroplasts ATP synthase is found on the thylakoid membrane

REVISED

In chloroplasts protons are pumped from the stroma into the thylakoid space, maintaining a high concentration gradient there. They then flow down their concentration gradient into the stroma, where there is a lower concentration of protons, through ATP synthase channels, producing ATP.

Revision activity

Create a Venn diagram showing the similarities and differences between the synthesis of ATP in mitochondria and in chloroplasts.

Practical skills

Investigation of dehydrogenase activity

In this practical you will be using methylene blue as an artificial hydrogen acceptor. When methylene blue accepts hydrogen it is reduced and turns from blue to colourless. The methylene blue accepts hydrogen from dehydrogenase reactions in respiration; the faster the rate of respiration, the faster the methylene blue will become reduced and decolourise.

- Add 10 cm^3 of yeast suspension to a test tube.
- Place the test tube in a water bath to equilibrate to 30°C.
- Add 1 cm^3 of methylene blue to the test tube.
- Mix by inverting the test tube once and start the stopwatch.
- Put the test tube back into the water bath to maintain the contents at 30°C.
- Time how long the indicator takes to turn from blue back to the original colour of the yeast suspension.

Practice questions

1 Explain the importance of allowing the test tube to equilibrate to 30°C.

2 Dehydrogenase reactions also take place in photosynthesis. Explain why these reactions would not affect this particular investigation.

Now test yourself

TESTED

1 What fuels the proton pumps in the electron transport chain?

2 What reaction is catalysed by ATP synthase?

3 Which area of the chloroplast has a high concentration of protons?

4 Where are stalked particles found in the mitochondria?

Summary

You should be able to:

- Describe the synthesis of ATP involving a flow of protons through the enzyme ATP synthase, the process of chemiosmosis and the electrochemical gradient.
- State the similarity between mitochondrial and chloroplast membrane function in providing a proton gradient for ATP synthesis.
- Explain how the proton gradient is maintained by proton pumps driven by potential energy associated with excited electrons.
- Describe the electron transport chain as an alternate arrangement of pumps and electron carriers.

Exam practice

1 The mitochondria of some plant cells were being studied.

a The pH values for the different parts of the mitochondria were studied. Suggest which area would be likely to have the lowest pH. Explain your answer. [2]

It was observed that as the plant cells aged, the surface area of the mitochondrial cristae decreased as the cristae receded.

b Suggest the effect this would have on the cell. [4]

The chloroplasts in the cells also had an intermembrane space between the external and inner membrane. Analysis showed that the inner membrane did not have any stalked particles.

c Explain this observation. [2]

2 Photosynthesis uses light energy to synthesise organic molecules

Angiosperm leaves are adapted to trap light for photosynthesis

Leaves are organs that are adapted in a number of ways to maximise the amount of light that is absorbed (Table 2.1).

Table 2.1 Adaptations of leaves for photosynthesis

Adaptation	Effect
The cuticle and epidermis are transparent	Allows light to pass through to the photosynthetic mesophyll tissue
Palisade mesophyll cells contain many chloroplasts, which are able to move within the cells	Maximises the absorption of light for photosynthesis
Well-developed xylem	Provides water – a reactant for photosynthesis
Well-developed phloem	Transports the products of photosynthesis

Making links

The adaptations of the leaf for photosynthesis are also covered in Year 1 work on gas exchange. Take this opportunity to review this section because the adaptations of the leaf for gas exchange are important in providing carbon dioxide for the leaf to photosynthesise.

In photosynthesis chloroplasts act as transducers

REVISED

Chloroplasts convert the energy from photons of light into chemical energy in the form of ATP. Photosynthesis occurs in the chloroplasts of plant cells on the thylakoid membrane, and in the thylakoid space and stroma (Figure 2.1).

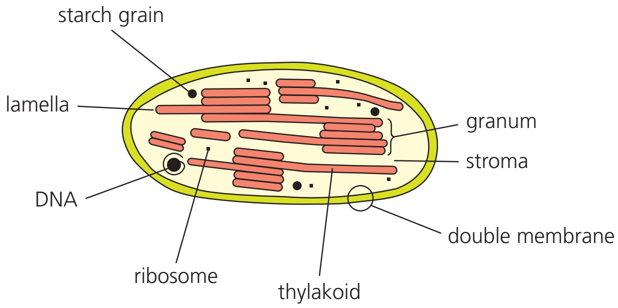


Figure 2.1 The structure of a chloroplast

Chloroplasts contain a number of different photosynthetic pigments

REVISED

Photosynthetic pigments absorb light energy, which is then used in photosynthesis. Different pigments absorb photons at different wavelengths of light.

- Chlorophyll a is the primary pigment and is found in the reaction centre of a photosystem (Figure 2.2).
- Accessory pigments, such as chlorophyll b, carotene and xanthophylls, are found in the antenna complex. They absorb light energy and transfer it to the chlorophyll a in the reaction centre. This process is known as light harvesting.

Photosynthetic pigments Molecules that absorb light energy for use in photosynthesis.

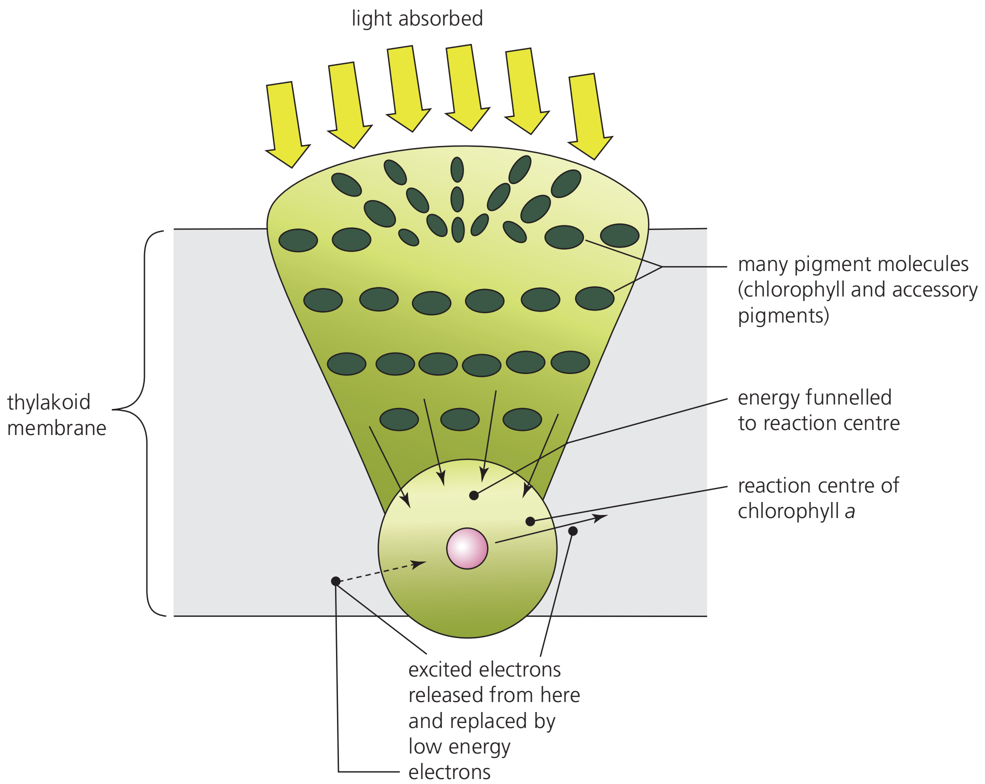


Figure 2.2 Structure of photosystems in the chloroplast membranes

Figure 2.3(a) shows the absorption of light by different pigments at different wavelengths of light. This is known as the absorption spectrum. As you can see, most light is absorbed at the red and blue ends of the spectrum, with little absorbed at green wavelengths of light. This shows that red light and blue light are absorbed by the chloroplasts and that green light is reflected.

The action spectrum in Figure 2.3(b) shows the rate of photosynthesis at different wavelengths of light. Again, you can see that the highest rates of photosynthesis occur at the blue and red ends of the spectrum, with very little photosynthesis occurring in the green part of the spectrum. This shows that the light absorbed by the photosynthetic pigments is the light used in biochemical reactions in photosynthesis.

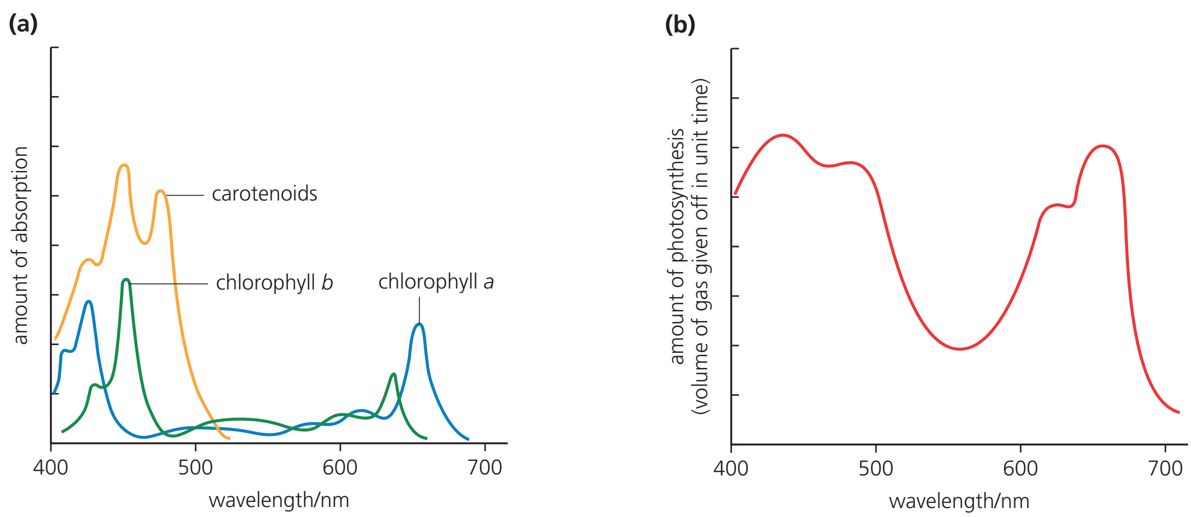


Figure 2.3 (a) Absorption spectra (b) action spectrum

Practical skills

Investigation into the separation of chloroplast pigments by chromatography

Photosynthetic pigments can be separated using chromatography (Figure 2.4). This technique relies on different pigments having different solubilities. This allows the calculation of specific Rf values, which can then be compared with known reference values and the pigments identified.

- Grind the leaves in a pestle and mortar with petroleum ether; this will release the pigments from the leaves.
- Draw a pencil line across the chromatography paper 2 cm from one end.
- Use a capillary tube to place a spot of the pigment in the centre of the pencil line. Wait for the spot to dry and then repeat the process until there is a small, dark spot on the paper.
- Pour propanone–petroleum ether solvent mixture into a boiling tube to a depth of 5 mm.
- Place the chromatography paper into the boiling tube; the end of the paper should be in the liquid, but the spot should be above the solvent. Do not touch the sides of the boiling tube with the paper when you are placing it in.
- Hold the chromatography paper in place with a bung or stopper.
- The solvent will move up the paper; remove it once the solvent is approximately 10 mm from the top of the paper.
- Use a pencil to draw a line to mark the point the solvent reached (this is the solvent front) and mark the top of each pigment spot (Figure 2.4).
- Use a ruler to measure the distance from the start point to the solvent front and the distance from the start point to each of the pigment spots.
- Use the equation below to calculate the Rf value of each pigment:

$$\text{Rf} = \frac{\text{distance travelled by pigment}}{\text{distance travelled by solvent front}}$$

- Compare the calculated Rf values with published values to identify each of the pigments.

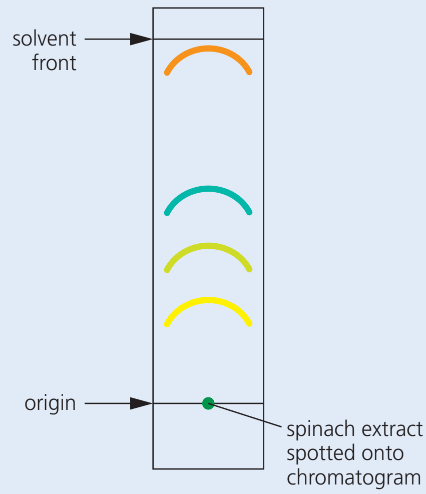


Figure 2.4 Chromatogram showing separation of photosynthetic pigments

Maths skills

Changing the subject of an equation and substituting numerical values into algebraic equations

The key to successfully solving equations is to work carefully and logically, ensuring that all substitutions are done correctly and all the functions in the equation are evaluated accurately. It is particularly important to double-check all your working – it is very easy to make a mistake not only when substituting values but also when rearranging the terms in an equation. Here we will be using the Rf equation.

Worked example

Calculate the distance moved by carotene if it has an Rf value of 0.94 and the solvent front moved 76 mm.

Answer

Step 1: Write down the equation that you need to use. The Rf equation is:

$$\text{Rf} = \frac{\text{distance travelled by pigment}}{\text{distance travelled by solvent front}}$$

Step 2: Since we want to find the distance moved by carotene, we need to make it the subject of the equation. To do this, multiply both sides by the distance travelled by the solvent front, which gives:

$$\text{distance travelled by pigment} = \text{Rf} \times \text{distance travelled by solvent front}$$

Step 3: Substitute the given values into the equation:

$$\text{distance travelled by pigment} = 0.94 \times 76 = 71\,\text{mm (to the nearest mm)}$$

Practice question

1 In an investigation into photosynthetic pigments, a pigment with an Rf value of 0.42 moves 84 mm during chromatography. Calculate how far the solvent front moved.

Now test yourself TESTED

1. What is represented by the action spectrum?
2. Give two examples of accessory pigments.
3. Calculate the distance moved by a pigment that has an Rf value of 0.54 when the solvent front moved 112 mm.
4. Where is the primary pigment found?

The thylakoid membrane has two different photosystems

Each photosystem is made up of an antenna complex and a reaction centre. Photosystem I (PS I) and photosystem II (PS II) each absorb light at different wavelengths.

Photosynthesis consists of the light-dependent and the light-independent stages

REVISED

The light-dependent stage consists of cyclic **photophosphorylation** and non-cyclic photophosphorylation and occurs on the thylakoid membrane.

In non-cyclic photophosphorylation:

- Photons of light are absorbed by the accessory pigments in the antenna complex of PS II. The excitation is then passed to the pair of chlorophyll a molecules in the reaction centre.
- An electron is excited from each of the chlorophyll a molecules and raised to a higher energy level. The excited electrons are passed to electron carriers, which they **reduce**, with the chlorophyll a molecule being **oxidised**.
- The electrons are passed along a series of electron carriers. The energy from these electrons is used to pump protons from the stroma to the thylakoid space. This increases the concentration of protons in the thylakoid space, lowering the pH and creating an electrochemical gradient. The protons then flow down this gradient through ATP synthase. This releases energy to form ATP.
- The process of light harvesting also occurs in PS I, with photons of light being absorbed by accessory pigments in the antenna complex and the energy then being passed to the pair of chlorophyll a molecules in the reaction centre. An electron is excited from each of the chlorophyll a molecules, and raised to a higher energy level. The electron reduces an electron acceptor and the chlorophyll a is oxidised. The electron acceptor passes the electron to NADP.
- Each NADP receives two electrons and picks up two hydrogen ions from the stroma to become reduced NADP (NADPH + H^+).
- The electrons lost from PS II must be replaced (those lost from PS I are replaced by the electrons from PS II). This is done by photolysis. Water molecules in the thylakoid spaces are split into hydrogen ions, electrons and oxygen. The hydrogen ions formed help to maintain the electrochemical gradient for the formation of ATP. The oxygen diffuses out of the chloroplast and is either used by the mitochondria in aerobic respiration or diffuses out into the atmosphere.

Photophosphorylation Phosphorylation of ADP to ATP using light as an energy source.

Reduction A gain of electrons.

Oxidation A loss of electrons.

Exam tip

Although photolysis is often described as the splitting of water using light, light is only indirectly involved – water only splits to replace the electrons lost from chlorophyll a.

Exam tip

Do not confuse NADP (the coenzyme reduced in non-cyclic photophosphorylation) with NAD (one of the coenzymes reduced in respiration).

Non-cyclic photophosphorylation can be represented by the Z-scheme (Figure 2.5).

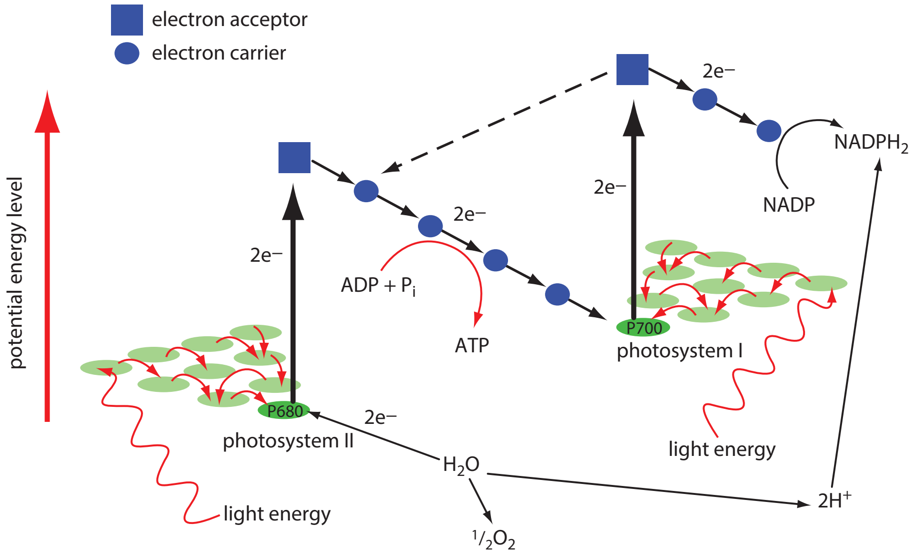


Figure 2.5 The light-dependent stage (Z-scheme)

Cyclic photophosphorylation involves only PS I

REVISED

- Light is absorbed by accessory pigments in the antenna complex and passed to chlorophyll a in the reaction centre.
- Electrons are excited and passed to the electron acceptor.
- The electrons are then passed along electron carriers, providing energy for protons to be pumped from the stroma to the thylakoid space, creating an electrochemical gradient, which is used to produce ATP. Then, as this is cyclic photophosphorylation, the electron is returned to PS I.

Cyclic photophosphorylation produces ATP but does not produce reduced NADP. Because the electrons return to PS I, and PS II is not involved, there is no need for photolysis to occur to replace the electrons lost. Therefore, oxygen is not also produced.

Revision activity

Draw out the stages of cyclic and non-cyclic photophosphorylation on a large sheet of paper. Cut the sections out, mix them up and then try to arrange them in the correct order.

Now test yourself

TESTED

5 Which coenzyme is reduced during non-cyclic photophosphorylation?
6 In which part of the chloroplast is there a high concentration of protons?
7 How are the electrons lost from PS II replaced?
8 How are the electrons lost from PS I in cyclic photophosphorylation replaced?

The products of non-cyclic photophosphorylation are used in the light-independent reaction

REVISED

The light-independent reaction is also known as the Calvin cycle, and occurs in the stroma. This is summarised in Figure 2.6.

- Carbon dioxide is fixed in a reaction with ribulose bisphosphate (a five-carbon compound). This reaction is catalysed by the enzyme rubisco. Two molecules of glycerate-3-phosphate (a three-carbon molecule) are formed.
- ATP and reduced NADP from the light-dependent reaction are used to reduce the glycerate-3-phosphate molecules to triose phosphate, which is also a three-carbon molecule.
- The triose phosphate molecules can then be used to make the products of photosynthesis and regenerate ribulose bisphosphate, via ribulose phosphate. This process also requires ATP.

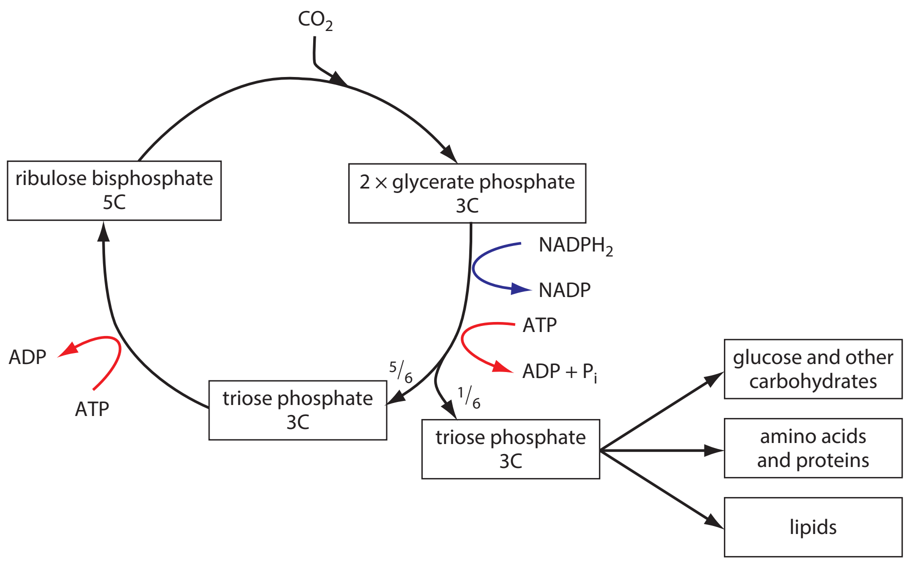


Figure 2.6 The light-independent stage (Calvin cycle)

On average one carbon is released per turn of the cycle. This means it requires six turns of the Calvin cycle to produce one molecule of glucose.

A number of different organic molecules can be produced by photosynthesis:

- glucose and other carbohydrates
- lipids
- amino acids – formed using nitrogen obtained from nitrates

Making links

Glucose is a monosaccharide. It is a hexose sugar because it has six carbon atoms. Amino acids comprise an amine group, a carboxyl group and a variable R group.

Practical skills

Investigation into the effect of light on the rate of photosynthesis

In this practical you will use algal balls to investigate the effect of light on the rate of photosynthesis. Single-celled algae are immobilised in alginate beads to form algal balls. The algal balls are placed in a hydrogencarbonate indicator solution, which changes colour when pH changes. When the algae are photosynthesising they will absorb carbon dioxide from the solution. This will increase the pH of the indicator solution, causing a colour change. The faster the rate of photosynthesis, the faster the rate of carbon dioxide absorption so the faster the rate of colour change.

If the algae are respiring faster than they are photosynthesising then carbon dioxide will be released into the solution. This will cause the solution to become more acidic, lowering the pH and producing a different colour change. The point where the rate of respiration is equal to the rate of photosynthesis is known as the compensation point; at this point there will be no change in the colour of the indicator.

- Place the algal balls in vials containing hydrogencarbonate indicator.
- Place the vials at set distances from a light source.
- After a set time take a sample of indicator from each of the vials and use a colorimeter to find its absorbance.

Worked example

The graph in Figure 2.7 shows the changes in pH from the starting pH at different distances from a lamp. Estimate the compensation point (the point where there is no uptake of carbon dioxide).

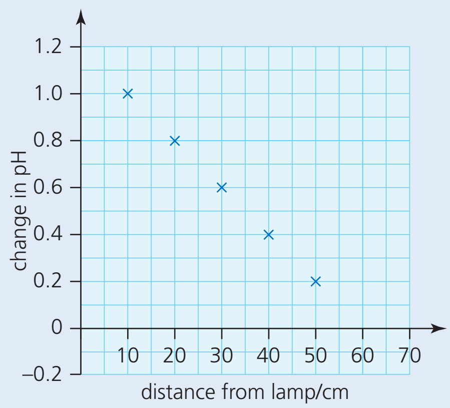


Figure 2.7

Answer

We need to find the value of *x* (distance from the lamp) at which the *y* value (change in pH) is zero; this is the *x*-axis intercept. Draw a straight line through the data points and look for where it crosses the *x*-axis (Figure 2.8).

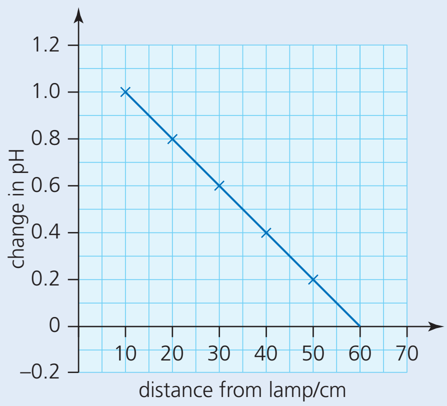


Figure 2.8

The intercept point is 60 cm from the light source. Therefore there is no change in pH at this point so it is the compensation point.

Practice question

2 The graph in Figure 2.9 shows data from a different investigation in which the rate of oxygen uptake of a plant at different light intensities was measured. Estimate the compensation point.

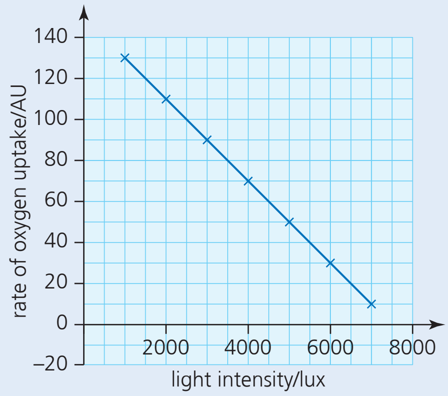


Figure 2.9

Photosynthesis is limited by the factor in shortest supply

Three main limiting factors affect the rate of photosynthesis

REVISED

- Light intensity – as light intensity increases, the rate of photosynthesis also increases due to an increase in the rate of the light-dependent reaction. This will continue until the rate of photosynthesis reaches a maximum; at this point another factor will limit the rate of photosynthesis.
- Temperature – as temperature increases, the rate of photosynthesis also increases. This occurs until the optimum temperature of the enzymes involved in photosynthesis is reached. As temperature increases above the optimum, the rate of reaction decreases as the enzyme denatures.
- Carbon dioxide concentration – as carbon dioxide concentration increases, the rate of photosynthesis also increases. This is due to increases in the rate of the light-independent reaction, of which carbon dioxide is a reactant.

The effects of these limiting factors are summarised in Figure 2.10.

Limiting factor A factor that limits the rate of a reaction.

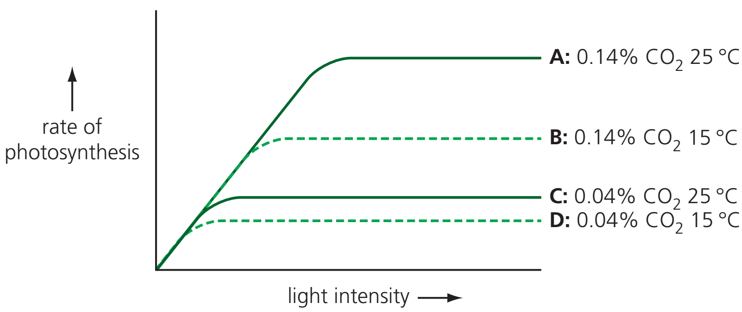


Figure 2.10 The effects of three limiting factors – light intensity, temperature and carbon dioxide concentration – on the rate of photosynthesis

Inorganic nutrients are important in plant metabolism

REVISED

If a plant is deficient in certain inorganic nutrients, such as nitrogen and magnesium, they can act as limiting factors for growth of the plant.

- Nitrogen is absorbed by the roots as nitrates. The nitrogen is used for the synthesis of proteins, nucleic acids and chlorophyll.
- Magnesium is used in the synthesis of chlorophyll. A lack of magnesium can lead to chlorosis (yellowing of leaves).

Making links

Nitrates in the soil are formed from ammonium ions by nitrifying bacteria.

Practical skills

Investigation into the role of nitrogen and magnesium in plant growth

In this practical you will be investigating the effect of growing seedlings in a solution that lacks nitrates and a solution that lacks magnesium. Plants require magnesium and nitrates for proper growth, so you should observe reduced growth in seedlings grown in the solutions lacking these when compared with those grown in the complete solutions. The dry masses should be measured because wet mass includes water the plant contains, so is not a good indication of plant growth.

- Set up test tubes containing complete culture solution, culture solution lacking nitrate and culture solution lacking magnesium.
- Place barley seedlings on cotton wool bungs covering the tops of the test tubes.
- Ensure that all the test tubes are in the same conditions, for example light and temperature.
- After a month record differences between the seedlings and measure the lengths of the roots and shoots.
- Use an oven to dry the seedlings and then measure the dry mass of each of them.

Now test yourself

TESTED

9 Which enzyme catalyses the reaction between carbon dioxide and ribulose bisphosphate in the light-independent reaction?

10 Where in the chloroplast does the light-independent reaction occur?

11 Which inorganic ion is required to form amino acids?

12 Which products of the light-dependent reaction are required in the Calvin cycle?

Summary

You should be able to:

- Explain how chloroplasts are adapted for absorbing a range of wavelengths of light.
- Describe the processes of non-cyclic and cyclic photophosphorylation.
- Describe the light-independent reaction.
- State the products of photosynthesis.
- Explain the effects of limiting factors on photosynthesis.
- Explain the roles of nitrogen and magnesium in plant metabolism.

Exam practice

1 The graph in Figure 2.11 shows the effect of carbon dioxide concentration on the rate of photosynthesis.

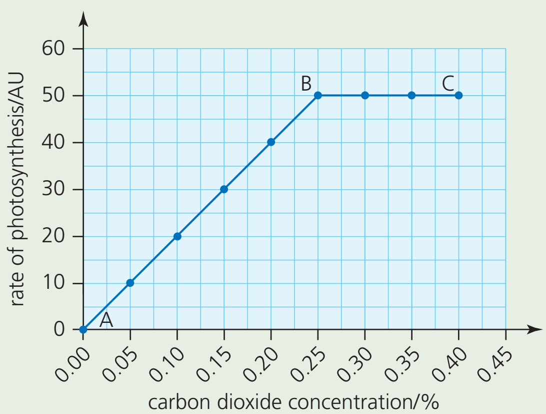


Figure 2.11

a Explain the shape of the curve between A and B. [4]

b Explain the shape of the curve between B and C. [3]

c A farmer was considering how to boost the yield of crops grown in a greenhouse. Suggest a suitable concentration of carbon dioxide for the farmer to use. Explain your answer. [2]

2 A researcher was studying the effects of a herbicide on the rate of photosynthesis in isolated chloroplasts.

a Explain why it was important to ensure the isolated chloroplasts were always kept in isotonic solutions. [2]

Some results from the investigation are listed below.

When the herbicide was added:

- No oxygen was produced by the chloroplasts.
- No glucose was produced.
- When ATP and reduced NADP were added to the chloroplasts, glucose was produced for a short time.
- Cyclic photophosphorylation continued.

b Suggest what can be concluded from these results. [5]

When the herbicide was used on plant cells the rate of respiration decreased but did not fall to zero immediately.

c Explain this observation. [2]

MY **REVISION** NOTES

WJEC/Eduqas A-level Year 2

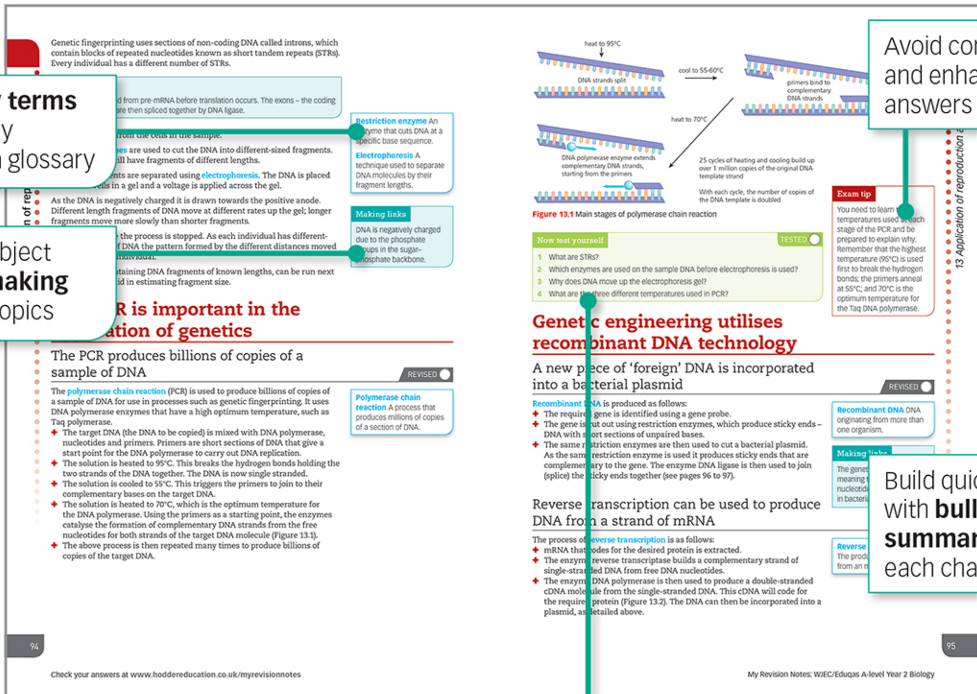
BIOLOGY

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 2 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 A-level Year 2 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

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

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

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

Practise and apply your skills and knowledge with **exam-style questions** and frequent **now test yourself** questions, and answer guidance online

HODDER EDUCATION

t: 01235 827827

e: education@hachette.co.uk

w: hoddereducation.co.uk

ISBN 978-1-3983-2724-5