edexcel

International GCSE

Biology (4BI0)

Teacher's guide

Issue 2

First examination 2011

ALWAYS LEARNING

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This teacher's guide is Issue 2. Key changes are sidelined. We will inform centres of any changes to this issue. The latest issue can be found on the Edexcel website: www.edexcel.com

Acknowledgements

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Authorised by Martin Stretton
Prepared by Tom Gudgeon

Introduction

The Edexcel International General Certificate of Secondary Education (International GCSE) in Biology is designed for schools and colleges. It is part of a suite of International GCSE qualifications offered by Edexcel.

About this guide

This guide is for teachers who are delivering, or planning to deliver, the Edexcel International GCSE in Biology qualification. The guide supports you in delivering the course content and explains how to raise the achievement of your students. The guide:

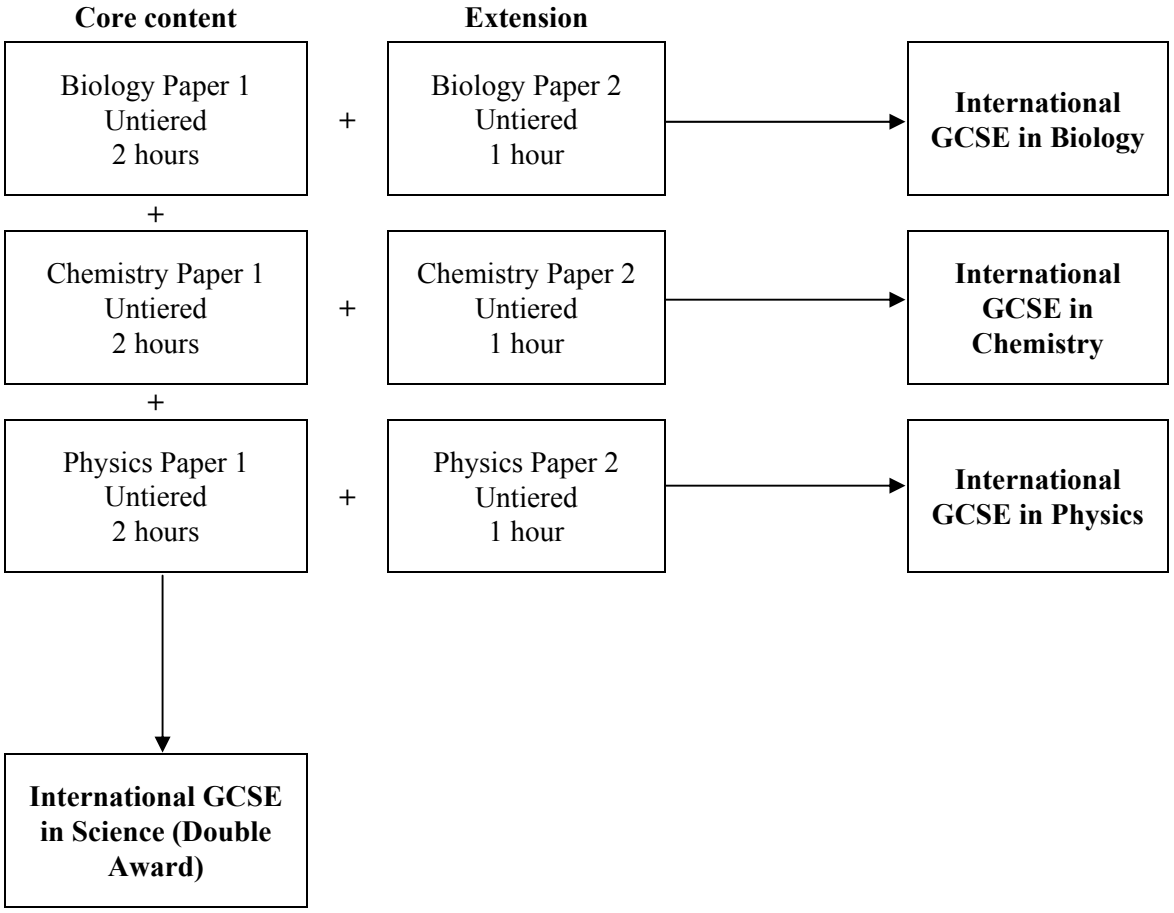
- gives essential information on the changes between this qualification and existing Edexcel and other international qualifications in the subject
- provides details of Assessment Objectives (AO) and criteria
- includes a list of command words that are directly linked to the Assessment Objectives
- gives you an example course planner
- provides experimental and investigative work that should be incorporated into teaching
- offers you suggestions for a range of resources.

Contents

Why choose this qualification?

The Edexcel International GCSE in Biology is designed for use in schools and colleges. It is part of the International GCSE suite of science qualifications offered by Edexcel. The course gives students the opportunity to experience biology within the context of their general education. The design of the course provides a basis for progression to further study in GCE Advanced Subsidiary and Advanced Level in Biology.

The relationship between assessment to the qualifications available is shown below.



Go to www.edexcel.com for more information about this International GCSE and related resources.

This qualification's key features and benefits are:

- aspects of science appropriate for the 21st century
- a linear, single-tier assessment
- assessment of investigative skills through an examination paper
- a foundation for progression to Edexcel GCE Advanced Subsidiary (AS) and Advanced level in Biology, and other comparable post-16 qualifications.

Support from Edexcel

We are dedicated to giving you exceptional customer service. Details of our main support services are given below. They will all help you to keep up to date with International GCSE 2009.

Website

Our website www.edexcel.com is where you will find the resources and information you need to successfully deliver International GCSE qualifications. To stay ahead of all the latest developments visit the microsite and sign up for our email alerts.

Ask Edexcel

Ask Edexcel is our free, comprehensive online enquiry service. Use Ask Edexcel to get the answer to your queries about the administration of all Edexcel qualifications. To ask a question please go to www.edexcel.com/ask and fill out the online form.

Ask the Expert

This free service puts teachers in direct contact with over 200 senior examiners, moderators and external verifiers who will respond to subject-specific queries about International GCSE 2009 and other Edexcel qualifications.

You can contact our experts via email or by completing our online form. Go to www.edexcel.com/asktheexpert for contact details.

Regional offices

If you have any queries about the International GCSE 2009 qualifications, or if you are interested in offering other Edexcel qualifications your Regional Development Manager can help you. Go to www.edexcel.com/international for details of our regional offices.

Training

A programme of professional development and training courses, covering various aspects of the specification and examination will be available. Go to www.edexcel.com for details.

Section A: Qualification content

Key subject aims

- To give students a knowledge and understanding of biological facts, concepts and principles.
- To develop an appreciation of the significance of biological facts, concepts and principles and the skills needed for their use in new and changing situations.
- To develop an appreciation of the importance of accurate experimental work in scientific method and reporting.
- To enable students to form hypotheses and design experiments to test them.
- To sustain and develop an enjoyment of, and interest in, the study of living organisms.
- To enable students to evaluate, in terms of their biological knowledge and understanding, the benefits and drawbacks of scientific and technological developments, including those related to social, environmental and economic issues.

Assessment and progression

- Single-tier; two exams; no coursework
- Grading A*-G
- Provides a sound foundation for progression to Edexcel GCE Advanced Subsidiary (AS) and Advanced level, and other comparable post-16 qualifications.

Information for Edexcel centres

We have made a minimum number of changes to the legacy International GCSE in Biology (4325). These changes include the removal of tiers, and the embedding of investigative skills throughout the assessment.

Comparison of the content from the Cambridge International Examinations (CIE) International GCSE in Biology (0610) to this qualification

Adapting from teaching the Cambridge International Examinations (CIE) course is simplified, as much of the content of the CIE and Edexcel specifications is common to both courses. Resources that are suitable for the CIE International GCSE will, therefore, also cover most of the Edexcel International GCSE. The additional content of the Edexcel course will be covered by the many textbooks available at this level. Schools currently teaching the CIE International GCSE should be able to continue with the same schemes of work as long as they are modified to reflect the changes in content.

The table below shows how the content of the legacy CIE International GCSE in Biology qualification (0610) maps to this qualification.

Legacy CIE content (0610)	This qualification content reference	In Edexcel qualification	In CIE qualification
Section I			
1 – Characteristics of living organisms	1.1	Yes	Yes
2 – Classification and diversity of living organisms	1.2	Yes: only plants animals, fungi, bacteria, protoctists and viruses in general	Yes: concentrates on binomial system and five vertebrate classes plus fungi, bacteria and viruses in general
3 – Simple keys		No	Yes
Section II			
1 – Cell structure and organisation	2.2, 2.3, 2.4	Yes	Yes
2 – Levels of organisation	2.1	Yes	Yes
3 – Size of specimens		No	Yes
4 – Movement in and out of cells	2.12, 2.13, **2.14**, 2.15, 2.16	Yes, but also introduces the concept of surface area to volume ratio	Yes, but expects an understanding of the term ‘water potential’
5 – Enzymes	2.8, 2.9, **2.10**, 2.11	Yes	Yes
6 – Nutrition	2.5, 2.6, 2.7, 2.17, 2.18, 2.19, 2.20, 2.21, 2.22, **2.23**, 2.24, **2.25**, 2.26, 2.27, 2.28, 2.29, 2.30, 2.31, **2.32**	Yes: additional material includes vitamin A and how to determine the energy content of a food sample	Yes: additional material includes food tests for protein and fat, food additives, enzymes in biological washing powders, malnutrition, obesity, the effects of alcohol, teeth and dental decay

Legacy CIE content (0610)	This qualification content reference	In Edexcel qualification	In CIE qualification
7 – Transportation	2.49, 2.50, **2.51**, 2.52, 2.53, 2.54, 2.55, 2.56, 2.57, 2.58, 2.59, 2.60, **2.61**, **2.62**, 2.63, 2.64, 2.65, 2.66	Yes, but in addition, includes vaccination and the concept of the secondary immune response	Yes, but includes the term 'translocation'
8 – Respiration and gas exchange	2.33, 2.34, 2.35, 2.36, **2.37**, 2.38, 2.39, **2.40**, 2.41, 2.42, **2.43**, 2.44, 2.45, 2.46, 2.47, 2.48	Yes	Yes
9 – Excretion in humans	2.67, 2.68, 2.69, 2.70, 2.71, 2.72, 2.73, 2.74, 2.75, 2.76	Yes, but also includes the role of ADH	Yes, but in addition, includes dialysis by kidney machines and kidney transplantation
10 – Coordination and response	2.77, 2.78, 2.79, 2.80, 2.81, 2.82, 2.83, 2.84, 2.85, 2.86, 2.87, **2.88**, **2.89**, 2.90	Yes	Yes, but ADH not specified. Additional content includes alcohol and heroin misuse and the personal and social problems arising from drug abuse
Section III			
1 – Reproduction	3.1, 3.2, 3.3, 3.4, **3.5**, **3.6**, 3.7, 3.8, 3.9, **3.10**, **3.11**, 3.12	Yes	Yes, but in addition, includes seed structure, seed and fruit dispersal, ante-natal care to include comparison between breast and bottle feeding, birth control, STD's, artificial insemination and fertility drugs
2 – Growth		No	Yes
3 – Inheritance	3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22, 3.23, 3.24, 3.25, 3.26, 3.27, 3.28, 3.29, 3.30, 3.31, 3.32, **3.33**	Yes, but in addition, expects an understanding of the basic structure of DNA	Yes, but in addition, expects an understanding of multiple allelic inheritance of blood groups and non disjunction leading to Down's syndrome

Legacy CIE content (0610)	This qualification content reference	In Edexcel qualification	In CIE qualification
Section IV			
1 – Energy flow	4.6, 4.7	Yes	Yes
2 – Food chains and food webs	4.4, 4.5	Yes	Yes
3 – Nutrient cycles	**4.8**, 4.9, **4.10**	Yes	Yes
4 – Population size	4.1, 4.2, 4.3	Yes	Yes, but also expects an graphical understanding of sigmoid growth curves and the influence of limiting factors
5 – Human influences on the ecosystem	4.11, 4.12, 4.13, 4.14, **4.15**, 4.16, 4.17	Yes	Yes
Section V			
1 – Food production	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, **5.7**, 5.8, 5.9	Yes, but in addition, expects advantages of pesticides, biological control, fermentation and fish farming	Yes, but in addition, expects an understanding of the problems caused by non-biodegradable plastic
2 – Selective breeding	5.10, 5.11	Yes	Yes
3 – Genetic modification	5.12, 5.13, 5.14, 5.15, **5.16**	Yes, but expects a wider range of examples	Yes
4 – Cloning	5.17, 5.18, 5.19, **5.20**	Yes	No

Numbers in **bold** relate to specification statements that are examined only in paper 2.

Section B: Assessment

This section describes the nature of assessment for this qualification including the logistics of examinations and what you can expect from the Edexcel examination papers.

Assessment overview

The table below gives an overview of the assessment for this course.

We recommend that you make this information available to students to help ensure they are fully prepared and know exactly what to expect in each assessment.

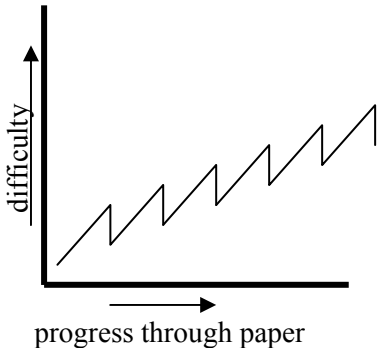
Paper 1	Percentage	Marks	Time	Availability
Biology Paper 1	$66\frac{2}{3}$	120	2 hours	January and June examination series First assessment June 2011
Paper 2	**Percentage**	**Marks**	**Time**	**Availability**
Biology Paper 2	$33\frac{1}{3}$	60	1 hour	January and June examination series First assessment June 2011

Assessment Objectives and weightings

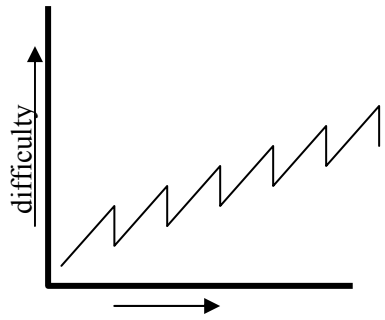
	% in International GCSE
AO1: Knowledge and understanding	45-55%
AO2: Application of knowledge and understanding, analysis and evaluation	25-35%
AO3: Investigative skills	20%
TOTAL	**100%**

Assessment summary

Paper 1	Description	Knowledge and skills

Biology Paper 1	• The time allowed for the examination is 2 hours. There are 120 marks available.
	• The paper has one section. All questions are compulsory – there is no choice of questions. All questions will be structured.
	• As you progress through a question it will become more difficult. As you progress through the paper the questions will generally increase in difficulty.
	 
	
	This means that the end of one question will often be more difficult than the start of the next question. Do not stop working just because you get stuck on one question.
	• This paper covers the full range of grades from G to A*.
	• All parts of the specification content except those printed in **bold** are covered.
	• Although all questions will be of the structured type, you can expect to find some questions requiring longer answers towards the end of the paper.
	• You should take into the examination:
	  • a **black** pen
	  • a pencil (for graphs)
	  • a rule
	  • an eraser
	  • a calculator.
		All three Assessment Objectives are covered. The breakdown of marks available is:
		AO1: 45%-55% (54 to 66 marks)
		AO2: 25%-35% (30 to 42 marks)
		AO3: 20% (24 marks)
		For AO1 you will be required to recall and show understanding of facts, terminology, principles, concepts and practical techniques. You will need to draw on your knowledge to show an understanding of the applications and implications of biology. You will need to make use of and present information logically and using appropriate vocabulary. No more than 50 per cent of the AO1 marks will be for direct recall.
		For AO2 you will be required to explain phenomena and interpret data based on you knowledge of biology. This may involve unfamiliar contexts and you should be able to use your knowledge and apply it to work out the answer. You will be required to carry out calculations; in calculations it is important that you show clearly all the steps of your working.
		For AO3 you will not be expected to need factual recall of biology. You will need to show that you are familiar with laboratory apparatus and its use, including the reading of scales. You may be asked to plan experimental procedures, to record results in table and/or to plot them on a graph and draw straight lines or curves of best fit. You will need to be able to offer explanations for results and to be able to spot anomalous results and suggest explanations for them. You are expected to be able to evaluate data obtained from experiments and experimental methods and to suggest improvements.
		To obtain a high mark you will need to be able to recall the factual content of the specification and apply those facts to novel situations. You will also need to be familiar with laboratory work and the way in which science is conducted in a practical situation.

Paper 2	Description	Knowledge and skills

Biology Paper 2	• The time allowed for the examination is 1 hour. There are 60 marks available.
	• The paper has one section. All questions are compulsory – there is no choice of questions. All questions will be structured.
	• As you progress through a question it will become more difficult. As you progress through the paper the questions will generally increase in difficulty.
	 
	
	This means that the end of one question will often be more difficult than the start of the next question. Do not stop working just because you get stuck on one question.
	• This paper targets grades from E to A*.
	• All parts of the specification (those in **bold** and those <u>not</u> in bold) are covered.
	• Although all questions will be of the structured type, you can expect to find some questions requiring longer answers towards the end of the paper.
	• You should take into the examination:
	  • a **black** pen
	  • a pencil (for graphs)
	  • a rule
	  • an eraser
	  • a calculator.
		All three Assessment Objectives are covered. The breakdown of marks available is:
		AO1: 45%-55% (27 to 33 marks)
		AO2: 25%-35% (15 to 21 marks)
		AO3: 20% (12 marks)
		For AO1 you will be required to recall and show understanding of facts, terminology, principles, concepts and practical techniques. You will need to draw on your knowledge to show an understanding of the applications and implications of biology. You will need to make use of and present information logically and using appropriate vocabulary. No more than 50 per cent of the AO1 marks will be for direct recall.
		For AO2 you will be required to explain phenomena and interpret data based on you knowledge of biology. This may involve unfamiliar contexts and you should be able to use your knowledge and apply it to work out the answer. You will be required to carry out calculations; in calculations it is important that you show clearly all the steps of your working.
		For AO3 you will not be expected to need factual recall of biology. You will need to show that you are familiar with laboratory apparatus and its use, including the reading of scales. You may be asked to plan experimental procedures, to record results in table and/or to plot them on a graph and draw straight lines or curves of best fit. You will need to be able to offer explanations for results and to be able to spot anomalous results and suggest explanations for them. You are expected to be able to evaluate data obtained from experiments and experimental methods and to suggest improvements.
		To obtain a high mark you will need to be able to recall the factual content of the specification and apply those facts to novel situations. You will also need to be familiar with laboratory work and the way in which science is conducted in a practical situation.

Command words

'Command words' used within the qualification in the specification include **describe**, **evaluate**, **explain**, **recall**, **recognise**, and **understand**.

These indicate the depth of knowledge and understanding required for a particular topic, and are also likely to be used in questions set on the topic.

Describe – students will be required to write prose answers to demonstrate the facts remembered about a topic.

Evaluate – students will be asked to analyse information and explain the underlying biology.

Explain – students will need to comment on the underlying biology.

Recall – students will be expected to remember brief facts.

Recognise – students will be expected to identify parts on a diagram.

Understand – students will need to appreciate the importance and relevance of biological facts.

Using the mark scheme

The mark scheme gives the responses we expect from students. Indicative answers are given but during the standardisation of examiners process the mark scheme is updated and expanded to cover unexpected, correct student responses.

Section C: Planning and teaching

Course planner

The scheme that follows shows a way to plan the teaching of this qualification, over five terms of 10 weeks. The scheme is described for teachers preparing students for Paper 1 and Paper 2; teachers preparing students for Paper 1 only can easily adapt the scheme by ignoring the topics in **bold type**.

Teachers may wish to plan their own scheme. This is perfectly acceptable and allows a degree of flexibility, but any approach must ensure full coverage of the specification content.

This course plan includes the practical work from the specification, but teachers are encouraged to include additional practical work as appropriate to their interest, and the time and facilities available.

Section 1 — The nature and variety of living organisms

To help teachers judge the depth of coverage required, the knowledge expected of a student has been given in full under each bullet point. The knowledge and ideas included in Section 1 are fundamental to the understanding of biology, so it is recommended that these topics should not be taught as a separate section but covered at appropriate points throughout the course, To allow teachers to incorporate the topics according to their own teaching preferences, they have not been included in the course plan outlined below. Teachers are reminded that approximately only 3 per cent of the final marks for the subject will be based on this section.

Students should be able to:

- recall that living organisms share the following basic characteristics
  - they require nutrition
  - they respire
  - they excrete their waste
  - they respond to their surroundings
  - they move
  - they control their internal conditions
  - they reproduce
  - they grow and develop.
- describe the features common to organisms within six main groups – plants, animals, fungi, bacteria, protoctists and viruses – and for each group describe examples and their features as follows (details of life cycle and economic importance are not required).
  - Plants: These are multicellular organisms; they contain chloroplasts and are able to carry out photosynthesis; they have cellulose cell walls; they store carbohydrates as starch or sucrose. Examples include flowering plants, such as cereals (for example maize) and herbaceous legumes (for example peas or beans).
  - Animals: These are multicellular organisms; they do not contain chloroplasts and are not able to carry out photosynthesis; they have no cell walls; they usually have nervous co-ordination and are able to move from one place to another; they often store carbohydrate as glycogen. Examples include mammals (for example humans) and insects (for example houseflies and mosquitoes).

- Fungi: These are organisms that are not able to carry out photosynthesis. Their body is usually organised into a mycelium made from thread-like structures called hyphae, which contain many nuclei; some examples are single-celled; they have cell walls made of chitin. They feed by extracellular secretion of digestive enzymes onto food material and absorption of the organic products; this is known as saprotrophic nutrition; they may store carbohydrate as glycogen. Examples include Mucor, which has the typical fungal hyphal structure, and yeast, which is single-celled.
- Bacteria: These are microscopic single-celled organisms; they have a cell wall, cell membrane, cytoplasm and plasmids; they lack a nucleus but contain a circular chromosome of DNA; some bacteria can carry out photosynthesis but most feed off other living or dead organisms. Examples include *lactobacillus bulgaricus*, a rod-shaped bacterium used in the production of yoghurt from milk, and *pneumococcus*, a spherical bacterium that acts as the pathogen causing pneumonia.
- Protoctists: These are microscopic single-celled organisms. Some such as *amoeba*, that live in pond water, have features like an animal cell, while others, such as *chlorella*, have chloroplasts and are more like plants. A pathogenic example is *plasmodium*, responsible for causing malaria.
- Viruses: These are small particles, smaller than bacteria; they are parasitic and can only reproduce inside living cells. They infect every type of living organism and have a wide variety of shapes and sizes. They have no cellular structure but have a protein coat and contain one type of nucleic acid, either DNA or RNA. Examples include the tobacco mosaic virus that causes discolouration of the leaves of tobacco plants by preventing the formation of chloroplasts, the influenza virus that causes 'flu' in humans and the HIV virus.

When covering these topics at appropriate points during the course, students should be able to recall the term 'pathogen' and know that pathogens may be fungi, bacteria, protoctists or viruses.

Term 1 of 5

Week	Topic	Content detail	Practical work
1-4	Nutrition in humans and biological molecules	• **Understand that a balanced diet should include carbohydrate, protein, lipid, vitamins, minerals, water and dietary fibre** • Recall sources and describe functions of carbohydrate, protein, lipid (fats and oils), vitamins A, C and D, and the mineral ions calcium and iron • **Understand that energy requirements vary with activity levels, age and pregnancy** • Recognise the structures of the human alimentary canal and outline the functions of the mouth, oesophagus, stomach, small intestine, large intestine and pancreas • Understand the processes of ingestion, digestion, absorption, assimilation and egestion • Explain how and why food is moved through the gut by peristalsis • Understand the role of digestive enzymes to include the digestion of starch to glucose by amylase and maltase, the digestion of proteins to amino acids by proteases and the digestion of lipids to fatty acids and glycerol by lipases • Recall that bile is produced by the liver and stored in the gall bladder, and understand the role of bile in neutralising stomach acid and emulsifying lipids • Explain how the structure of a villus helps absorption of the products of digestion in the small intestine • **Recall how to carry out a simple experiment to determine the energy content in a food sample** • Recall the chemical elements present in carbohydrates, proteins and lipids (fats and oils)	• **Recall how to carry out a simple experiment to determine the energy content in a food sample** • Describe the tests for glucose and starch • Describe how to carry out simple controlled experiments to illustrate how enzyme activity can be affected by changes in temperature.

Week	Topic	Content detail	Practical work
1-4 *Cont*	Nutrition in humans and biological molecules	• Describe the structure of carbohydrates, proteins and lipids as large molecules made up from smaller basic units: starch and glycogen from simple sugars; protein from amino acids; lipid from fatty acids and glycerol • Describe the tests for glucose and starch • Understand the role of enzymes as biological catalysts in metabolic reactions • Understand how the functioning of enzymes can be affected by changes in temperature **and pH** • Describe how to carry out simple controlled experiments to illustrate how enzyme activity can be affected by changes in temperature	
5	Respiration	• Recall that the process of respiration releases energy in living organisms • Describe the differences between aerobic and anaerobic respiration • Recall the word equation and the balanced chemical symbol equation for aerobic respiration in living organisms • Recall the word equation for anaerobic respiration in plants and in animals • **Describe simple controlled experiments used to demonstrate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms**	• **Describe simple controlled experiments used to demonstrate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms.**

Week	Topic	Content detail	Practical work
6-7	Gas exchange in humans	• Describe the structure of the thorax, including the ribs, intercostal muscles, diaphragm, trachea, bronchi, bronchioles, alveoli and pleural membranes • Understand the role of the intercostal muscles and the diaphragm in ventilation • Explain how alveoli are adapted for gas exchange by diffusion between air in the lungs and blood in capillaries • Understand the role of diffusion in gas exchange • Understand the biological consequences of smoking in relation to the lungs and the circulatory system • Describe a simple experiment to investigate the effect of exercise on breathing in humans.	• Describe a simple experiment used to investigate the effect of exercise on breathing in humans.
8-10	Transport in humans	• Recall the composition of the blood: red blood cells, white blood cells, platelets and plasma • Understand the role of plasma in the transport of carbon dioxide, digested food, urea, hormones and heat energy • Describe the adaptations of red blood cells for the transport of oxygen, including shape, structure and the presence of haemoglobin • Describe how the immune system responds to disease using white blood cells, illustrated by phagocytes ingesting pathogens and lymphocytes releasing antibodies specific to the pathogen • Understand that vaccination results in the manufacture of memory cells, which enables future antibody production to the pathogen to occur sooner, faster and in greater quantity	• Describe a simple practical on the effects of exercise on heart rate in humans.

Week	Topic	Content detail	Practical work
8-10 *Cont*	Transport in humans	• **Recall that platelets are involved in blood clotting, which prevents blood loss and the entry of micro-organisms** • Describe the structure of the heart and how it functions • Understand that the heart rate changes during exercise and under the influence of adrenaline • Describe the structure of arteries, veins and capillaries and understand their roles • Recall the general plan of the circulation system, including the blood vessels to and from the heart, the lungs, the liver and the kidneys	

Term 2 of 5

Week	Topic	Content detail	Practical work
1-2	Cell structure	• Describe the levels of organisation within organisms: organelles, cells, tissues, organs and systems • Recognise cell structures, including the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and vacuole • Describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and vacuole	• Describe simple experiments on diffusion and osmosis using living and non-living systems.
	Movement of substances into and out of cells	• Describe the differences between plant and animal cells • Recall simple definitions of diffusion, osmosis and active transport • Understand that movement of substances into and out of cells can be by diffusion, osmosis and active transport • **Understand the importance in plants of turgid cells as a means of support**	

Week	Topic	Content detail	Practical work
1-2 *Cont*	Movement of substances into and out of cells	• Understand the factors that affect the rate of movement of substances into and out of cells to include the effects of surface area to volume ratio, temperature and concentration gradient • Understand why simple, unicellular organisms can rely on diffusion for movement of substances in and out of the cell • Understand the need for a transport system in multicellular organisms • Describe simple experiments on diffusion and osmosis using living and non-living systems	
3-4	Human excretion	• Recall that the lungs, kidneys and skin are organs of excretion • Understand how the kidney carries out its roles of excretion and of osmoregulation • Describe the structure of the urinary system, including the kidneys, ureters, bladder and urethra • Describe the structure of a nephron, to include Bowman's capsule and glomerulus, convoluted tubules, loop of Henlé and collecting duct • Describe ultrafiltration in the Bowman's capsule and the composition of the glomerular filtrate • Understand that water is reabsorbed into the blood from the collecting duct • Understand that selective reabsorption of glucose occurs at the proximal convoluted tubule • Describe the role of ADH in regulating the water content of the blood • Recall that urine contains water, urea and salts	

Week	Topic	Content detail	Practical work
5-6	Human coordination and response Homeostasis	• Understand that organisms are able to respond to changes in their environment • Understand that homeostasis is the maintenance of a constant internal environment and that body water content and body temperature are both examples of homeostasis • Understand that a coordinated response requires a stimulus, a receptor and an effector • **Describe the role of the skin in temperature regulation, with reference to sweating, vasoconstriction and vasodilation** • Understand the sources, roles and effects of the following hormones: ADH, adrenaline, insulin, testosterone, progesterone and oestrogen	
7-8	Nerves and eye	• Describe how responses can be controlled by nervous or by hormonal communication and understand the differences between the two systems • Recall that the central nervous system consists of the brain and spinal cord and is linked to sense organs by nerves • Understand that stimulation of receptors in the sense organs sends electrical impulses along nerves into and out of the central nervous system, resulting in rapid responses • Describe the structure and functioning of a simple reflex arc illustrated by the withdrawal of a finger from a hot object • Describe the structure and function of the eye as a receptor • **Understand the function of the eye in focusing near and distant objects, and in responding to changes in light intensity**	• Describe a simple experiment to show how the sensitivity of skin differs on fingers, back of hand, wrist and forearm.

Week	Topic	Content detail	Practical work
9-10	Plant coordination and response	• Understand that plants respond to stimuli • Describe the geotropic responses of roots and stems • Describe positive phototropism of stems	• Recall controlled experiments to demonstrate phototropic and geotropic plant growth responses.

Term 3 of 5

Week	Topic	Content detail	Practical work
1-2	Plant nutrition	• Describe the process of photosynthesis and understand its importance in conversion of light energy to chemical energy • Recall the word equation and the balanced chemical symbol equation for photosynthesis • Understand how carbon dioxide concentration, light intensity and temperature affect the rate of photosynthesis • Explain how the structure of the leaf is adapted for photosynthesis • Recall that plants require mineral ions for growth and that magnesium ions are needed for chlorophyll and nitrate ions are needed for amino acids • Describe simple controlled experiments to investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll	• Describe simple controlled experiments used to investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll.

Week	Topic	Content detail	Practical work
3-4	Plant gas exchange	• Understand gas exchange (of carbon dioxide and oxygen) in relation to respiration and photosynthesis • **Understand that respiration continues during the day and night, but that the net exchange of carbon dioxide and oxygen depends on the intensity of light** • Explain how the structure of the leaf is adapted for gas exchange • Describe the role of stomata in gas exchange • **Describe simple controlled experiments to investigate the effect of light on net gas exchange from a leaf, using hydrogen-carbonate indicator** • Recall the origin of carbon dioxide and oxygen as waste products of metabolism and their loss from the stomata of a leaf	• **Describe simple controlled experiments to investigate the effect of light on net gas exchange from a leaf, using a hydrogen-carbonate indicator.**
5	Plant transport	• **Describe the role of phloem in transporting sucrose and amino acids between the leaves and other parts of the plant** • Describe the role of the xylem in transporting water and mineral salts from the roots to other parts of the plant • Explain how water is absorbed by root hair cells • Recall that transpiration is the evaporation of water from the surface of a plant • Explain how the rate of transpiration is affected by changes in humidity, wind speed, temperature and light intensity • Describe experiments that investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot	• Describe experiments that investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot.

Week	Topic	Content detail	Practical work
6-8	The organism in the environment and feeding relationships	• Understand the terms population, community, habitat and ecosystem • Recall the use of quadrats to estimate the population size of an organism in two different areas • Describe the use of quadrats as a technique for sampling the distribution of organisms in their habitats • Recall the names given to different trophic levels to include producers, primary, secondary and tertiary consumers and decomposers • Understand the concepts of food chains, food webs, pyramids of number, pyramids of biomass and pyramids of energy transfer • Understand the transfer of substances and of energy along a food chain • Explain why only about 10 per cent of energy is transferred from one trophic level to the next	• Use quadrats to estimate the population size of an organism in two different areas.
9-10	Carbon, nitrogen and water cycles	• **Describe the stages in the water cycle, including evaporation, transpiration, condensation and precipitation** • Describe the stages in the carbon cycle, including respiration, photosynthesis, decomposition and combustion • **Describe the stages in the nitrogen cycle, including the roles of nitrogen fixing bacteria, decomposers, nitrifying bacteria and denitrifying bacteria (specific names of bacteria are not required)**	

Term 4 of 5

Week	Topic	Content detail	Practical work
1-3	Reproduction	• Describe the differences between sexual and asexual reproduction • Understand that fertilisation involves the fusion of a male and female gamete to produce a zygote that undergoes cell division and develops into an embryo • Describe the structures of an insect-pollinated and a wind-pollinated flower and explain how each is adapted for pollination • Understand that the growth of the pollen tube followed by fertilisation leads to seed and fruit formation • **Recall the conditions needed for seed germination** • **Understand how germinating seeds utilise food reserves until the seedling can carry out photosynthesis** • Understand that plants can reproduce asexually by natural methods (illustrated by runners), and by artificial methods (illustrated by cuttings) • Recall the structure and function of the male and female reproductive systems • Understand the roles of oestrogen and progesterone in the menstrual cycle • **Describe the role of the placenta in the nutrition of the developing embryo** • **Understand how the developing embryo is protected by amniotic fluid** • Recall the roles of oestrogen and testosterone in the development of secondary sexual characteristics	• Compare structures in an insect-pollinated and a wind-pollinated flower using suitable local specimens.

Week	Topic	Content detail	Practical work
4-6	Inheritance	• Recall that the nucleus of a cell contains chromosomes on which genes are located • Understand that a gene is a section of a molecule of DNA • Understand that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics • Recall the meaning of the terms dominant, recessive, homozygous, heterozygous, phenotype, genotype **and codominance** • Describe patterns of monohybrid inheritance using a genetic diagram • Understand how to interpret family pedigrees • Predict probabilities of outcomes from monohybrid crosses • Recall that the sex of a person is controlled by one pair of chromosomes, XX in a female and XY in a male • Describe the determination of the sex of offspring at fertilisation, using a genetic diagram • Understand that random fertilisation produces genetic variation of offspring • Recall that in human cells the diploid number of chromosomes is 46 and the haploid number is 23 • Understand that variation within a species can be genetic, environmental, or a combination of both • Recall that mutation is a rare, random change in genetic material that can be inherited • Understand that many mutations are harmful but some are neutral and a few are beneficial • Describe the process of evolution by means of natural selection	

Week	Topic	Content detail	Practical work
4-6 *Cont*	Inheritance	• Understand how resistance to antibiotics can increase in bacterial populations • Understand that the incidence of mutations can be increased by exposure to ionising radiation (eg gamma rays, X-rays and ultraviolet rays) and some chemical mutagens (eg chemicals in tobacco)	
7-8	Cell division	• Understand that division of a diploid cell by mitosis produces two cells which contain identical sets of chromosomes • Understand that mitosis occurs during growth, repair, cloning and asexual reproduction • Understand that division of a cell by meiosis produces four cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes	
9	Cloning	• Describe the process of micropropagation (tissue culture) in which small pieces of plants (explants) are grown in vitro using nutrient media • Understand how micropropagation can be used to produce commercial quantities of identical plants (clones) with desirable characteristics • Describe the stages in the production of cloned mammals involving the introduction of a diploid nucleus from a mature cell into an enucleated egg cell, illustrated by Dolly the sheep • Evaluate the potential for using cloned transgenic animals, for example, to produce commercial quantities of human antibodies or organs for transplantation	
10	Selective breeding	• Understand that plants with desired characteristics can be developed by selective breeding • Understand that animals with desired characteristics can be developed by selective breeding	

Term 5 of 5

Week	Topic	Content detail	Practical work
1-2	Food production and fish farming	• Describe how glasshouses and polythene tunnels can be used to increase the yield of certain crops • Understand the effects on crop yield of increased carbon dioxide and increased temperature in glasshouses • Understand the use of fertiliser to increase crop yield • Understand the reasons for pest control and the advantages and disadvantages of using pesticides and biological control with crop plants • Explain the methods which are used to farm large numbers of fish to provide a source of protein, including maintenance of water quality, control of intraspecific and interspecific predation, control of disease, removal of waste products, quality and frequency of feeding and the use of selective breeding	
3-4	Genetic modification	• Describe a DNA molecule as two strands coiled to form a double helix, the strands being linked by a series of paired bases: adenine (A) with thymine (T), and cytosine (C) with guanine (G) • Describe the use of restriction enzymes to cut DNA at specific sites and ligase enzymes to join pieces of DNA together • Describe how plasmids and viruses can act as vectors, which take up pieces of DNA, then insert this recombinant DNA into other cells • Understand that large amounts of human insulin can be manufactured from genetically modified bacteria that are grown in a fermenter • Evaluate the potential for using genetically modified plants to improve food production (illustrated by plants with improved resistance to pests) • Recall that the term ‘transgenic’ means the transfer of genetic material from one species to a different species	

Week	Topic	Content detail	Practical work
5-6	Micro-organisms	• Understand the role of yeast in the production of beer • Describe a simple experiment to investigate carbon dioxide production by yeast, in different conditions • **Understand the role of bacteria (lactobacillus) in the production of yoghurt** • Interpret and label a diagram of an industrial fermenter and explain the need to provide suitable conditions in the fermenter, including aseptic precautions, nutrients, optimum temperature and pH, oxygenation and agitation, for the growth of micro-organisms	• Describe a simple experiment used to investigate carbon dioxide production by yeast in different conditions.
7-9	Human influences on the environment	• Understand the biological consequences of pollution of air by sulphur dioxide and by carbon monoxide • Recall that water vapour, carbon dioxide, nitrous oxide, methane and CFCs are greenhouse gases • Understand how human activities contribute to greenhouse gases • Understand how an increase in greenhouse gases results in an enhanced greenhouse effect and that this may lead to global warming and its consequences • **Understand the biological consequences of pollution of water by sewage including increases in the number of micro-organisms causing depletion of oxygen** • Understand that eutrophication can result from leached minerals from fertiliser • Understand the effects of deforestation, including leaching, soil erosion, disturbance of the water cycle and of the balance in atmospheric oxygen and carbon dioxide	
10	Revision		• Use sample assessment materials as practice for examination.

Teaching ideas — experimental and investigative work

Experimental work is an integral part of the study of biology so it is appropriate that assessment of experimental and investigative skills should form approximately 20 per cent of the final assessment.

It is strongly recommended that 20 per cent of the teaching time should be devoted to practical work carried out by the students themselves. However, there may be circumstances where it is possible for the work to be carried out in small groups or even by demonstration alone. Between 24 and 30 of the 120 marks in Paper 1 will be set as questions with a practical bias, along with approximately 12 of the 60 marks in Paper 2.

Many of the topics in the specification should be taught in a way that allows the facts to arise from practical work, rather than the practical work being used to demonstrate what the students have already been taught.

Students are expected to acquire skills that allow them to be assessed on their ability to:

- plan experimental procedures
- describe practical techniques and take measurements
- analyse evidence and draw conclusions, communicating findings using calculations, tables and graphs
- evaluate evidence.

The sample assessment materials, which comprise of papers and mark schemes, have been produced to illustrate the types of question that will be asked.

There will be one continuous prose practical question in Paper 1 that will test student understanding of the importance of:

- having a control, or a range of values for the independent variable
- ensuring standardisation of the organism involved
- replication to ensure reliability
- measuring quantitatively, accurately and with precision
- ensuring standardisation of all other variables that could influence measurement of the dependent variable.

Training students in practical skills

Students should be offered as many opportunities as possible to plan and carry out experimental tasks and whole investigations themselves, and to practise the skills needed to achieve their highest potential in this work.

Many students will need considerable guidance in order to progress from simply carrying out a set of practical instructions provided by the teacher, to the point where they are able to plan and carry out a whole investigation themselves, and critically evaluate the outcome. However, the effort required will be well rewarded, as the student will then fully understand the principles and parameters on which scientific method is based. Indeed, the heuristic approach to teaching biology will help students take in the practical skills on which they will be assessed, and it will enable them to tackle questions with greater confidence.

Students would benefit from being introduced to the concept of practical investigative work well before they begin the two-year examination course. Research evidence has shown that students take a considerable time to gain the confidence needed for higher-level investigative skills such as critical evaluation.

Students might be given the opportunity to attempt whole investigations. Before this, they should be given experimental tasks that test only one or two skill areas. For example, as an introduction to the concept of planning whole investigations, students could be asked to write a plan for an experiment that is subsequently carried out in class.

Students should be encouraged to participate in practical work wherever possible. The scheme is designed to encourage a wide variety of activities, including those based on the collection of first-hand evidence and those that depend on secondary evidence. (The term 'evidence' is used to mean observations, measurements or other data.)

A list of the practical work and investigations that are included in the specification is given below, together with a small sample of other practicals. This practical work will give students opportunities to acquire necessary skills. It is hoped that teachers will extend the list for their students to allow them to gain further confidence in practical work, its analysis and evaluation.

Practical work and student investigations

1 Tests for glucose and starch, lipid and protein

2 Controlled experiments to illustrate how enzyme activity can be affected by changes in temperature

3 Simple experiments on diffusion and osmosis using living and non-living systems

4 Controlled experiments to investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll

5 **A simple experiment to determine the energy content of a food sample**

6 **Controlled experiments to demonstrate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms**

7 **Simple controlled experiments to investigate the effect of light on net gas exchange from a leaf, using hydrogen-carbonate indicator**

8 A simple experiment to investigate the effect of exercise on breathing in humans

9 Experiments to investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot

10 A simple experiment to investigate the effect of exercise on heart rate in humans

11 A simple experiment to show how the sensitivity of the skin differs on finger tips, back of hand, wrist and forearm

12 A practical exercise comparing floral structure in insect-pollinated and wind-pollinated flowers

13 Controlled experiments to demonstrate phototropic and geotropic plant growth responses

14 The use of quadrats to estimate the population size of an organism in two different areas

15 A simple experiment to investigate carbon dioxide production by yeast in different conditions.

Advice on how to approach each of the listed experiments or investigations is given below. It is not obligatory to follow this advice; it is recognised that there are many ways in which the practical work could be carried out to fulfil the training in practical skills.

1 Tests for glucose, starch, lipid and protein

The tests that are expected:

- Benedict's test for glucose
- iodine test for starch (test not required by specification)
- the emulsion test for lipid
- biuret reagent for protein(test not required by specification).

These tests could be carried out:

- on prepared samples of pure substances
- on foods that contain the substances
- in a context.

Example

To demonstrate health applications, a fake 'urine sample' can be made by colouring water with iodine solution. A similar solution, with glucose added, could mimic the urine of an untreated diabetic. Students can use Benedict's test to identify the diabetic.

The iodine test could be introduced when teaching that plants manufacture starch by photosynthesis, or when investigating the effect of amylase on starch digestion.

2 Controlled experiments to illustrate how enzyme activity can be affected by changes in temperature

The effect of amylase on starch digestion is a particularly easy system to use. At each temperature selected, from 0°C to 100°C, samples of amylase solution and of starch solution are brought to temperature before being added together. The mixture is then kept at the same temperature. To measure the rate of reaction, drops of the mixture can be collected at intervals of one minute and added to individual iodine drops on a white tile. The time taken for the starch to disappear is recorded for each temperature.

Temperature-controlled water baths help the students, but stable temperatures can also be achieved by using beakers of water, thermometers, ice and Bunsen burners.

There is plenty of scope for students working individually to plan how to keep all variables except for temperature the same, to consider repetition, to display their results in tables and to plot them as graphs, and to evaluate their results.

Catalase is another enzyme that can be used. There are a number of sources, but potato or liver are most commonly used. Catalase converts hydrogen peroxide into water and oxygen. The rate of oxygen production can be measured as an indication of enzyme activity. An upturned burette previously filled with water can be used to collect and measure the volume of oxygen evolved. Hydrogen peroxide is toxic and so great care needs to be taken with its use.

3 Simple experiments on diffusion and osmosis using living and non-living systems

a Cubes of agar jelly placed into solutions of methylene blue or potassium permanganate will absorb the pigment by diffusion. The cubes are left in the pigmented solution for different measured periods of time and are then sliced open. The distance between the edge of each cube and the edge of the coloured agar may be used as a measure of the distance the pigment molecules have moved by diffusion.

b A crystal of potassium permanganate can be dropped into a beaker of water and the appearance of the water noted over time.

c To demonstrate osmosis, Visking tubing (dialysis tubing) can be tied at one end and filled with 20 per cent sucrose solution. The other end is attached to a capillary tube. The level of the sucrose can be noted before and after the tubing has been placed in a beaker of water for about 30 minutes.

d Onion epidermis can be peeled away, cut into squares and mounted on slides in different concentrations of sucrose solution. Observation under a microscope will show the effects of osmosis.

e Red blood cells in blood obtained from a butcher may be mounted on slides in hypotonic, isotonic and hypertonic saline, and observed under a microscope to show the effects of osmosis.

f Osmosis can be demonstrated by using strips of potato, and this basic experimental method provides a good opportunity for students to carry out individual whole investigations. Because of the difficulty of the osmosis concept, it is better to keep this investigation until the latter part of the course so that students will have had previous experience of carrying out investigations on simpler topics. Students enjoy the reference to 'chips', but should quickly realise that it can be difficult to keep the size constant – to achieve consistency lengths of potato tissue can be drilled from a potato using a cork borer. The 'chips' are measured by mass or by length and are placed into sucrose solutions of different concentrations for at least one hour. The percentage change in mass or length is a measure of the degree of osmosis that has occurred.

g A variation on this theme is to cut potato cubes of different sizes, which have different surface area to volume ratios. After measuring and recording the masses of the cubes, they are immersed in water. After one hour, the cubes are blotted dry and their masses measured and recorded again. The percentage increase in mass for cubes of different surface area to mass ratio can be compared, to explore the concept of how surface area to volume ratio influences water uptake.

4 Controlled experiments to investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch by leaves and the requirements for light, carbon dioxide and chlorophyll

a The evolution of oxygen from a water plant can be seen if a water plant (typically *elodea* or a similar species) is placed in a beaker of water and covered with a glass funnel that has a water-filled test tube placed over its opening. After 24 hours, a colourless gas will have displaced water from the test tube. A test for oxygen is then carried out.

b To measure the rate of oxygen production, the stem of a water plant is cut under water, and the plant kept immersed in water in a beaker or boiling tube. The number of bubbles of gas given off over a measured time period can be counted. This simple experimental set up can enable students to carry out individual investigations into the effect of different factors on the rate of bubble production. Suitable variables include: light intensity (the plant is exposed to a light source and the rate of bubble production measured at different light intensities by changing the distance between the light source and the water plant); colour/wavelength of light (coloured filters are placed between the plant and the light source); and carbon dioxide availability (the plant is immersed in solutions of different concentration of sodium hydrogen carbonate).

c Starch production can be investigated by placing a plant in the dark for 24 hours to de-starch the leaves. A starch test on a leaf from a plant that has been kept in the dark will not give a blue-black colour, whereas a similar test on a control leaf from a plant kept in the light will give a blue-black colour.

d A starch test on a variegated leaf can be used to demonstrate that chlorophyll is needed for photosynthesis.

e To show that carbon dioxide is needed for photosynthesis, a leaf on a plant may be surrounded by air with no carbon dioxide by inserting it into a conical flask containing a small amount of potassium or sodium hydroxide. The plant is left in good light for 24 hours. The test leaf and a control leaf from the plant are then tested for starch*.

*To test leaves for starch:

- drop into very hot/boiling water for one minute (to destroy the cell membranes so that chlorophyll molecules can pass through)
- drop into hot ethanol (to remove/dissolve the green chlorophyll)
- place leaf into water (to rehydrate and soften the leaf so that it can be spread out)
- drop iodine solution onto the leaf (test for starch) – blue-black colour will show the presence of starch.

These experiments provide opportunities for students to demonstrate safe handling of equipment and materials and in the use of controls.

5 A simple experiment to determine the energy content of a food sample

Fat-containing foods such as dried crisps work very well.

- A known mass of the food sample is weighed and the mass noted.
- A boiling tube is prepared, containing a known volume of water. The water temperature is recorded.
- The food sample is put in a crucible or burning spoon and ignited (for example in the flame of a Bunsen burner).
- The food sample is quickly placed under the boiling tube. As soon as the food sample has completely burnt the water temperature in the boiling tube is re-measured.
- The equation used to calculate the energy content of the food is:

$$\text{Energy content of food sample (joules per gram)} = \frac{}{\text{mass of water heated (g) x temperature rise } (^{o}\text{C}) \text{ x } 4.2 \text{ x } 1/\text{mass of food sample (g)}}$$

Warning! Peanuts should not be used as the food sample because some people have a serious allergic reaction to them.

To obtain an accurate result, all the energy in the food sample needs to be transferred to the water. Students could be asked to think of the reasons **why** this method produces an inaccurate result and to suggest ways in which the apparatus could be modified to make the result more accurate.

6 Controlled experiments to demonstrate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms

Vacuum flasks are needed for this activity. Surface sterilised seeds are put into a flask, which is sealed with a bung. A glass tube runs from inside the flask, through the bung and into an indicator solution of either limewater or hydrogen carbonate. The carbon dioxide produces changes the colour of the indicator solution. To show heat production the flask needs a cotton wool bung with a thermometer going through the bung into the flask.

Students could demonstrate that they produce carbon dioxide by breathing out through a tube into lime water or hydrogen carbonate indicator.

7 Simple controlled experiments to investigate the effect of light on net gas exchange from a leaf, using hydrogen carbonate indicator

A water plant can be placed in a sealed tube of air-equilibrated hydrogen carbonate solution (red in colour) and placed in the light or in the dark. The solution will turn purple if kept in the light and will turn yellow if kept in the dark.

A variation could involve the use of water snails or, if not available, small land insects placed on a gauze platform above the indicator, with and without the water plant. This variation allows students to think about the balance between carbon dioxide used by photosynthesis and carbon dioxide produced by respiration.

A useful demonstration uses four tubes containing hydrogen carbonate solution: one with water plant only, one with animals only, one with both water plant and animals and one with no living organisms. One set of the tubes is exposed to light and left for 12 to 24 hours and another set is placed in the dark for the same length of time.

8 A simple experiment to investigate the effect of exercise on breathing in humans

The breathing rate can be measured at rest and after a period of exercise by counting the number of inhalations per minute.

To help students appreciate that exercise also influences the rate of breathing by increasing the volume of each breath they can measure the volume of one exhalation before and after exercise. This can be done by breathing through a tube into a plastic container filled with water. The volume of displaced water can be measured. The breathing rate at rest and after exercise can be calculated as number of breaths per minute x volume of each breath.

Students may need to work in pairs: one to carry out the investigation and take measurements and the other as the subject of the investigation.

Students' health must be considered if they are to be the subject of this investigation with regard to asthma or other breathing conditions.

9 Experiments to investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot

A bubble potometer can be used to illustrate the effects of light, wind, temperature and air humidity. Plants covered with dark polythene bags simulate darkness and can be compared with plants covered with transparent polythene bags. Hairdryers can simulate wind. The use of potted plants is also acceptable, where the pot and the soil is sealed with polythene and the mass of the potted plant is measured before and after a period of exposure to the environmental factor.

10 A simple experiment to investigate the effect of exercise on heart rate in humans

Students should be shown how to measure and record their pulse. They can measure this at rest. A short period of exercise can follow, stepping on and off a low stool, or running up and down a flight of stairs for five minutes. (Safety note: careful supervision is required.)

The pulse rate should now be recorded for five minutes or until it returns to its rest level. This experiment can provide a great deal of interesting data on the variation in resting heart rate, the effects of exercise and how quickly the heart recovers. Discussion can include measures of fitness, heart disease, cardiac output and the effects of long-term exercise on stroke volume.

11 A simple experiment to show how the sensitivity of the skin differs on finger tips, back of hand, wrist and forearm

Students should work in pairs. A piece of hard cardboard or cork can be used to fix the two prongs of a hairpin or two pins 5 mm apart. This is then used by one student to lightly touch the fingertips of another who is looking away. The first student can use both points or one point as a stimulus. The second student then has to judge whether one or two points were used and their response recorded as correct or incorrect. This can be repeated 10 times for each area of the hand. It is then repeated using pins 1 cm apart and 2 cm apart.

Students can then identify the most sensitive area as this should have the most correct responses with the smaller distance. Conclusions can be made about the number of sensory nerve endings, receptive field size and the thickness of skin. This practical also provides opportunities to discuss data analysis, experiment design and anomalous results, and the benefits of grouping class results.

12 A practical exercise comparing floral structure in insect-pollinated and wind-pollinated flowers

Most areas should have access to suitable specimens. Insect-pollinated flowers can be examined and the various structures observed. Wind-pollinated grasses should be available but have fewer structures to see. Teachers should demonstrate the features.

13 Controlled experiments to demonstrate phototropic and geotropic plant growth responses

Plant material such as wheat, maize, oat or cress seedlings can be used to demonstrate phototropism. Petri dishes containing moist cotton wool and the plant material can be put into light-proof boxes such as shoe boxes. To create unilateral light a small slit can be cut in one side of the box and light can be shone into the box. Control seedlings can either have aluminium caps put on their tips or can be kept in a shoe box without a slit for light. A klinostat needs to be used to demonstrate geotropism.

14 The use of quadrats to estimate the population size of an organism in two different areas

Quadrats can be used to sample part of each area. Calculation will be needed to work out the estimated population size. For example, if 10 quadrats have been used and the total area amounts to 100 quadrats, the estimated population size will be the number of organisms counted in the 10 sample quadrats multiplied by 10.

Students are expected to understand the importance of placing the sample quadrats randomly.

An interesting way to practise the technique is to throw plastic beads on the floor of the classroom and ask students to guess how many beads there are. The quadrat sampling procedure can be used in front of students to get an estimate. The beads can then be collected and counted. The actual number can be compared to the estimated number and used to see how accurate the estimation was.

15 A simple experiment to investigate carbon dioxide production by yeast in different conditions

This allows students to see that carbon dioxide is released during anaerobic respiration (fermentation).

Students add yeast to glucose solution in a side-arm test tube. Anaerobic conditions are achieved by putting a drop of oil (cooking oil will do) onto the yeast and glucose mixture. A rubber tube is attached to the side arm of the test tube and a glass pipette is inserted at the other end of the rubber tube. The pipette is placed under water to allow the bubbles of carbon dioxide gas to be counted. Temperature is the easiest condition to investigate. Glucose concentration and pH could also be investigated.

Teaching time for each section of the qualification content

The questions on the examination papers will take into account the different amount of content within each of the sections. The table below gives a guide to the approximate number of marks allocated to each section and the amount of teaching time recommended for each section.

Section topics — teaching time and mark allocation

Section topic		Recommended time allocation for teaching	Paper 1 approximate mark allocation (out of 120)	Paper 2 approximate mark allocation (out of 60)
1	The nature and variety of living organisms	3%	3	1
2	Structures and functions in living organisms	50%	60	31
3	Reproduction and inheritance	15%	18	9
4	Ecology and the environment	15%	18	9
5	Use of biological resources	17%	21	10

Resources

Please note that while resources are correct at the time of publication, they may be updated or withdrawn from circulation. Website addresses may change at any time.

Textbook

The following textbook is recommended for this course:

Potter S and Bradfield P – *Longman Biology for IGCSE* (Longman, 2004) ISBN 1405802065

Websites

Teachers will find a good deal of useful information on the following websites.

Association for Science Education	www.ase.org.uk
BBC Education (revision guides)	www.bbc.co.uk/education/gcsebitesize
BBC Science	www.bbc.co.uk/science
Biochemistry Society	www.biochemistry.org
Biotechnology and Biological Research Council	www.bbsrc.ac.uk
BP Amoco Educational Service	www.bpes.com
British Association for the Advancement of Science	www.britassoc.org.uk
British Library	www.bl.uk
Esso	www.esso.co.uk
Friends of the Earth	www.foe.co.uk
Institute of Education (London)	www.ioe.ac.uk
Multimedia – Key Concepts in Science	www.new-media.co.uk
New Scientist	www.newscientist.com
Practical Biology	www.practicalbiology.org
School Science	www.schoolscience.org.uk
School Science Service	www.cleapss.org.uk
Science Consortium	www.scienceconsortium.co.uk
Science Enhancement Programme	www.sep.org.uk
Science Museum	www.sciencemuseum.org.uk
Shell	www.shell.co.uk

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