GATEWAY SCIENCE SUITE

GCSE BIOLOGY B

ACCREDITED SPECIFICATION

J263

VERSION 2

MAY 2012

WELCOME TO GCSE SCIENCES

THOUSANDS OF TEACHERS ALREADY UNLEASH THE JOY OF SCIENCE WITH OCR.

A FEW GOOD REASONS TO WORK WITH OCR

- You can enjoy the **freedom and excitement** of teaching science qualifications which have been developed to help you inspire students of all abilities.
- We've built specifications **with you in mind**, using a clear and easy-to-understand format, making them straightforward for you to deliver.
- Our **clear and sensible assessment** approach means that exam papers and requirements are clearly presented and sensibly structured for you and your students.
- **Pathways for choice** – we have the broadest range of science qualifications and our GCSEs provide an ideal foundation for students to progress to more-advanced studies and science-related careers.
- **Working in partnership to support you** – together with teachers we've developed a range of practical help and support to save you time. We provide everything you need to teach our specifications with confidence and ensure your students get as much as possible from our qualifications.
- **A personal service** – as well as providing you with lots of support resources, we're also here to help you with specialist advice, guidance and support for those times when you simply need a more individual service.

HERE'S HOW TO CONTACT US FOR SPECIALIST ADVICE:

By phone: 01223 553998

By email: science@ocr.org.uk

By online: http://answers.ocr.org.uk

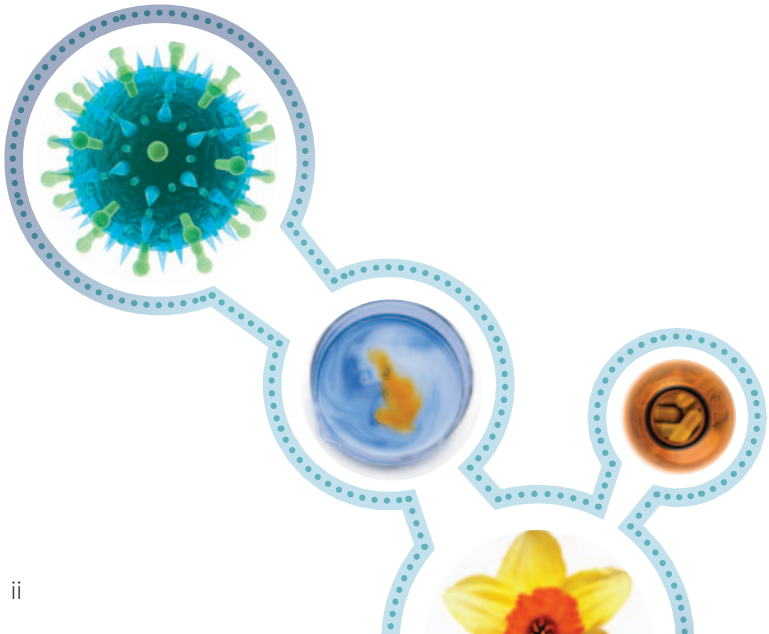
By fax: 01223 552627

By post: Customer Contact Centre, OCR, Progress House, Westwood Business Park, Coventry CV4 8JQ

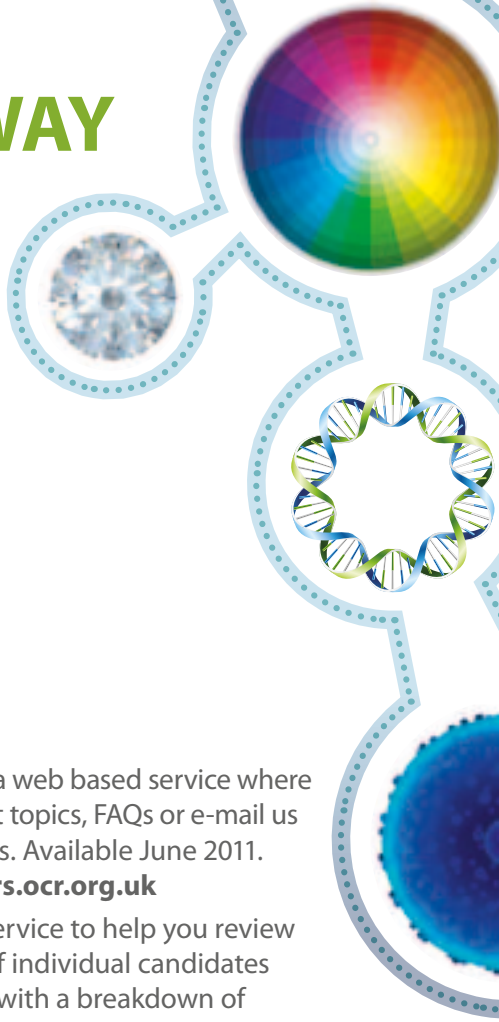
DON'T FORGET

– you can download a copy of this specification and all our support materials at

www.ocr.org.uk/gcse2012



SUPPORTING YOU ALL THE WAY



Our aim is to help you at every stage and we work in close consultation with teachers and other experts to provide a practical package of high quality resources and support.

Our support materials are designed to save you time while you prepare for and teach our new specifications. In response to what you have told us we are offering detailed guidance on key topics, controlled assessment and curriculum planning.

Our essential FREE support includes:

Materials

- Specimen assessment materials and mark schemes
- Guide to controlled assessment
- Sample controlled assessment material
- Exemplar candidate work
- Teacher's handbook
- Sample schemes of work and lesson plans
- Guide to curriculum planning
- Frequently asked questions
- Past papers.

You can access all of our support at:
www.gcse-science.com

Training

Our GCSE Science Get Started events:

- include useful information about our specifications direct from the experts
- are designed to assist you in preparing to teach
- provide you with an opportunity to speak face-to-face with our team.

We're also developing online support and training for those unable to get away from school.

Go to **www.ocr.org.uk/science2011/training** for full details and to book your place.

Science Community

Join our social network at **www.social.ocr.org.uk** where you can start discussions, ask questions and upload resources.

Services

- **Answers @ OCR –** a web based service where you can browse hot topics, FAQs or e-mail us with your questions. Available June 2011. Visit **http://answers.ocr.org.uk**
- **Active Results** – service to help you review the performance of individual candidates or a whole school, with a breakdown of results by question and topic.
- **Local cluster support networks** – supported by OCR, you can join our local clusters of centres who offer each other mutual support.

Endorsed publisher partner materials

We're working closely with our publisher partner Collins Education to ensure effective delivery of endorsed materials when you need them.
Find out more at:
www.collinseducation.com/newgcsescience

WHAT TO DO NEXT

1) Sign up to teach – let us know you will be teaching this specification to ensure you receive all the support and examination materials you need. Simply complete the online form at **www.ocr.org.uk/science/signup**

2) Become an approved OCR centre – if your centre is completely new to OCR and has not previously used us for any examinations, visit **www.ocr.org.uk/centreapproval** to become an approved OCR centre.

GATEWAY SCIENCE SUITE

Science in Action

Understand the questions that science can answer. Unpick the scientific concepts and investigate their familiar applications through active learning.

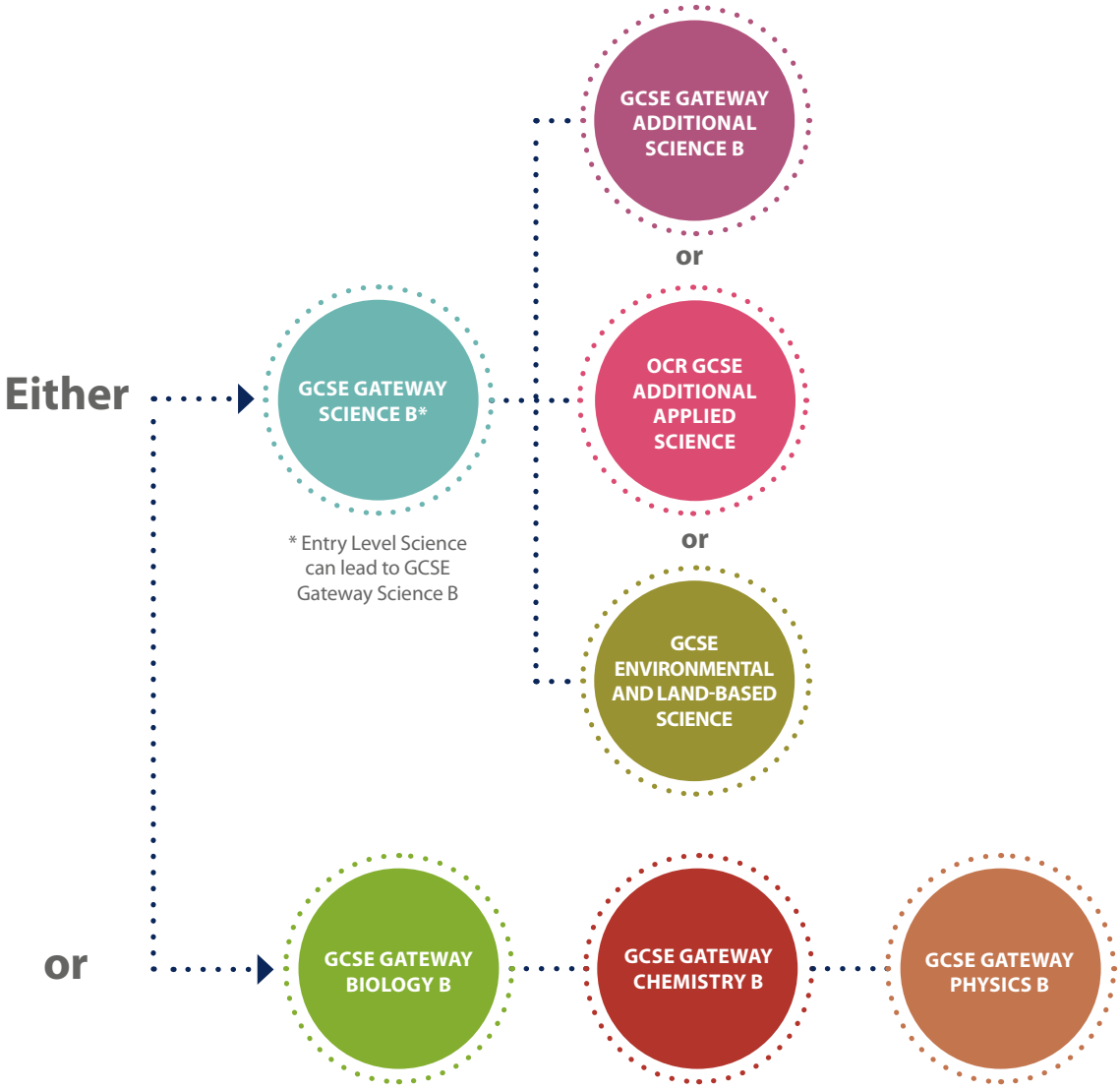
Our Gateway Science Suite gives you and your students:

- an emphasis on getting more involved in the learning process through a variety of interesting activities and experiences, identifying links to scientific ideas and their implications for society
- the opportunity to develop scientific explanations and theories.

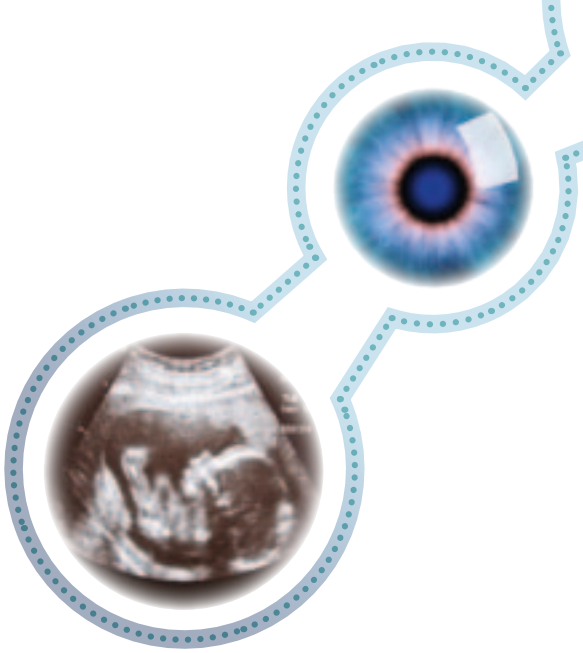
KEY FEATURES

- **Flexible assessments**, which can be carried out at the end of the course or at times during the course when students' understanding is at its best.
- **Unique assessment approach** – more straightforward to manage and puts you in greater control, while making it easier to manage resits (for example 40% weighted unit resit of one unit rather than two and meets the terminal rule).
- **Practical work** is at the heart of the Gateway Science Suite.

POSSIBLE GCSE COMBINATIONS



GCSE BIOLOGY B



KEY FEATURES

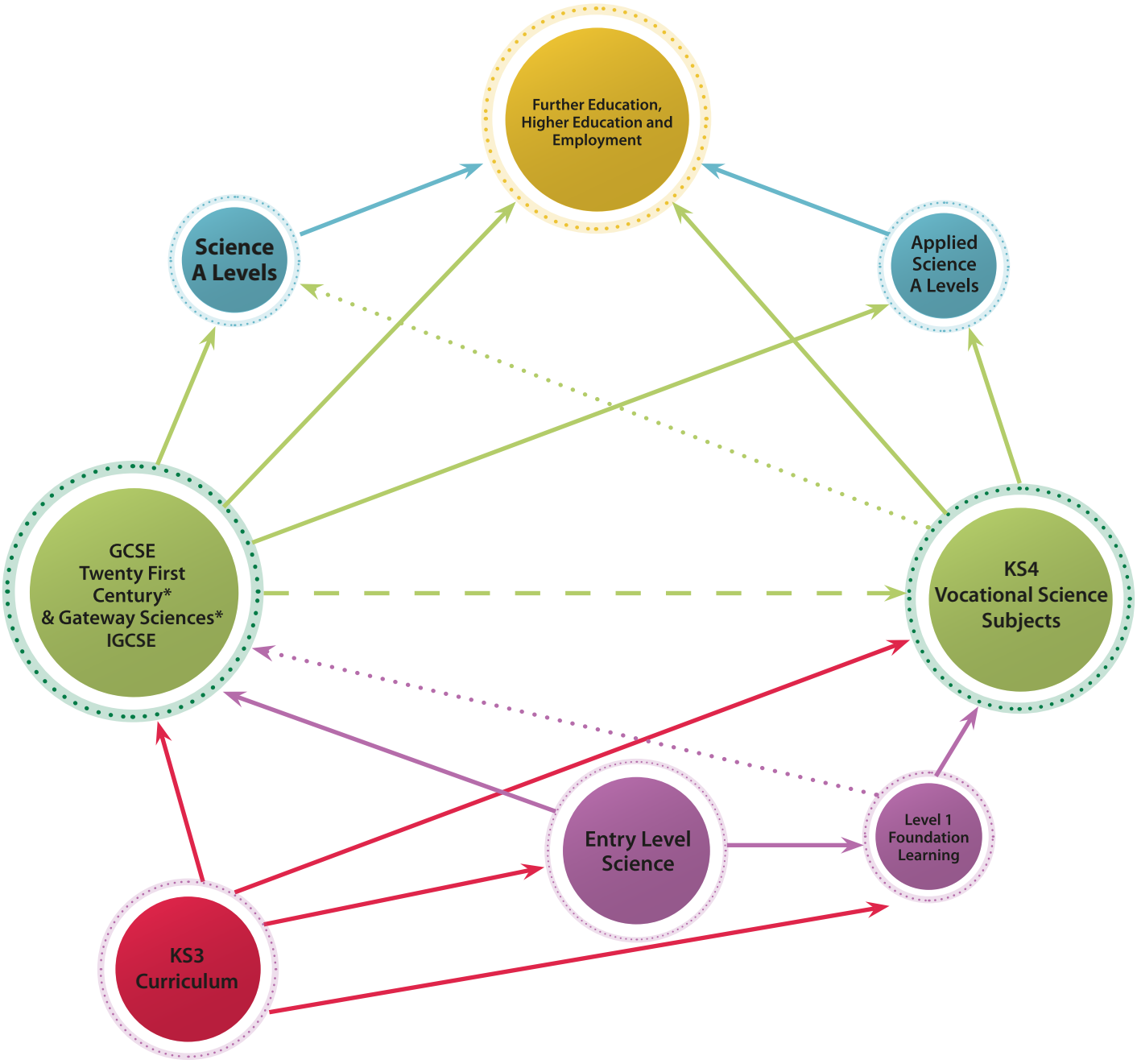
GCSE Biology B aims to give students opportunity to:

- develop their interest in, and enthusiasm for, biology
- develop a critical approach to scientific evidence and methods
- acquire and apply skills, knowledge and understanding of how science works and its essential role in society
- acquire scientific skills, knowledge and understanding necessary for progression to further learning.

GCSE Biology B provides distinctive and relevant experience for students who wish to progress to Level 3 qualifications.

COURSE OVERVIEW	ASSESSMENT OVERVIEW		
UNIT B731 Module B1: Understanding Organisms Module B2: Understanding Our Environment Module B3: Living And Growing	75 marks 1 hour 15 minutes written paper	**35%** of total GCSE	Two written exams, assessed externally by OCR, each of which: • is offered in Foundation and Higher Tiers • uses structured questions (there is no choice of questions) • assesses the quality of written communication Unit B732 also includes a 10 mark data response section which assesses AO3 (analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence)
UNIT B732 Module B4: It's A Green World Module B5: The Living Body Module B6: Beyond The Microscope	85 marks 1 hour 30 minutes written paper	**40%** of total GCSE	
UNIT B733 Controlled assessment	48 marks Approx 7 hours	**25%** of total GCSE	Comprises one assessment task, split into three parts Assessed by teachers, internally standardised and then externally moderated by OCR Assesses the quality of written communication

PROGRESSION PATHWAYS IN SCIENCE



This could be a progression route along a particular curriculum pathway. (Stage, not age pathways)

This could be a progression route however students would require additional support.

Alternative qualification options

* Offered as
Science, Additional Science, Biology, Chemistry and Physics.

Contents

Contents

Contents

Introduction to the Gateway Suite

1

The Gateway Science Suite comprises five specifications which share a common approach, utilise common material, use a similar style of examination questions and have a common approach to skills assessment.

The qualifications available as part of this suite are:

- GCSE Science
- GCSE Additional Science
- GCSE Biology
- GCSE Chemistry
- GCSE Physics.

The suite emphasises explanations, theories and modelling in science along with the implications of science for society. Strong emphasis is placed on the active involvement of candidates in the learning process and each specification encourages a wide range of teaching and learning activities.

The suite is supported by resources published by Collins.

OCR also offers a specification in GCSE Additional Applied Science which may be taken as an alternative to GCSE Additional Science.

2 Introduction to GCSE Biology B

2.1 Overview of GCSE Biology B

Unit B731 *Biology modules B1, B2, B3*

This is a tiered unit offered in Foundation and Higher Tiers.

Written paper

1 hour 15 mins – 75 marks

35% of the qualification

Question paper comprises structured questions. Candidates answer all questions.

+

Unit B732 *Biology modules B4, B5, B6*

This is a tiered unit offered in Foundation and Higher Tiers.

Written paper

1 hour 30 mins – 85 marks

40% of the qualification

Question paper comprises structured questions and analysis of data.

Candidates answer all questions.

+

Unit B733 *Biology controlled assessment*

This unit is not tiered.

Controlled assessment

48 marks

25% of the qualification

2.2 What is new in GCSE Biology B?

	What stays the same?	What changes?
Structure	• Three units, comprising two externally assessed units and one internally assessed unit. • Externally assessed units are tiered – Foundation and Higher tier. • Unit weightings – Unit B731 still 35%, Unit B732 still 40%. • Controlled assessment still 25% weighting.	• The course will be assessed as linear.
Content	• Content is divided into 6 modules, B1 – B6	
Assessment	• Papers include structured questions and objective questions. • The internally assessed unit is based on a single investigative task divided into three parts. • There will be a choice of controlled assessment tasks, set by OCR, valid for entry in one year only. • Unit B731 paper is 1 hour 15 mins long, with a total of 75 marks. • Unit B732 paper is 1 hour 30 mins long, with a total of 85 marks including a 10 mark analysis of evidence section. • How Science Works will be assessed in all units. • Quality of written communication will be assessed in all units.	• New 100% assessment rules apply to science GCSEs. All units, including written papers, available for assessment in June series only.

2.3 Guided learning hours

GCSE Biology B requires 120–140 guided learning hours in total.

2.4 Aims and learning outcomes

GCSE specifications in Biology should encourage learners to develop their curiosity about the living world and provide insight into and experience of how science works. They should enable learners to engage with biology in their everyday lives and to make informed choices about further study in biology-related disciplines and about career choices.

The aims of this specification are to enable candidates to:

- develop their knowledge and understanding of biology
- develop their understanding of the effects of biology on society
- develop an understanding of the importance of scale in biology
- develop and apply their knowledge and understanding of the nature of science and of the scientific process
- develop their understanding of the relationships between hypotheses, evidence, theories and explanations
- develop their awareness of risk and the ability to assess potential risk in the context of potential benefits
- develop and apply their observational, practical, modelling, enquiry and problem-solving skills and understanding in laboratory, field and other learning environments
- develop their ability to evaluate claims based on science through critical analysis of the methodology, evidence and conclusions both qualitatively and quantitatively
- develop their skills in communication, mathematics and the use of technology in scientific contexts.

2.5 Prior learning

Candidates entering this course should have achieved a general educational level equivalent to National Curriculum Level 3, or an Entry 3 at Entry Level within the National Qualifications Framework.

Content of GCSE Biology B

3

3.1 Summary of content

The specification content is presented as six modules which are listed below. Within each module the content is shown as eight items (e.g. B1a, B1b, B1c, B1d, B1e, B1f, B1g and B1h). Thus, the specification content contains a total of 48 teaching items. Each item requires approximately 2½ hours teaching time.

Module B1: *Understanding Organisms*	Module B2: *Understanding Our Environment*	Module B3: *Living And Growing*
a Fitness and health	a Classification	a Molecules of life
b Human health and diet	b Energy flow	b Proteins and mutations
c Staying healthy	c Recycling	c Respiration
d The nervous system	d Interdependence	d Cell division
e Drugs and you	e Adaptations	e The circulatory system
f Staying in balance	f Natural selection	f Growth and development
g Controlling plant growth	g Population and pollution	g New genes for old
h Variation and inheritance	h Sustainability	h Cloning
Module B4: *It's A Green World*	**Module B5: *The Living Body***	**Module B6: *Beyond The Microscope***
a Ecology in the local environment	a Skeletons	a Understanding microbes
b Photosynthesis	b Circulatory systems and the cardiac cycle	b Harmful microorganisms
c Leaves and photosynthesis	c Running repairs	c Useful microorganisms
d Diffusion and osmosis	d Respiratory systems	d Biofuels
e Transport in plants	e Digestion	e Life in soil
f Plants need minerals	f Waste disposal	f Microscopic life in water
g Decay	g Life goes on	g Enzymes in action
h Farming	h Growth and repair	h Gene technology

3.2 Layout of teaching items

The detailed specification content is displayed in tabular format, designed to provide a 'teacher-friendly' approach to the content. This allows teachers to see, at a glance, links between the development of skills and understanding of how science works, and the knowledge and understanding of different science ideas and contexts. The layout of each module follows the outline given below.

Module Code and Title (e.g. Understanding Organisms)

Item code and title: e.g. B1a: Fitness and health

Summary: A short overview of the item, including the skills, knowledge and understanding of how science works that may be covered within this item.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Ideas for teaching activities related to the item, which will integrate the skills, knowledge and understanding of how science works into a teaching scheme. Teachers may choose from these suggestions or develop other comparable activities.	Learning outcomes that will only be assessed in the Foundation Tier paper. The use of bullet points provides guidance on: • depth • context • exemplification.

Module Code and Title

Item code and title: e.g. B1a: Fitness and health

Links to other items: Opportunities for linking ideas across modules within the Gateway suite of sciences.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Learning outcomes that can be assessed on either the Foundation Tier or Higher Tier question papers. The use of bullet points provides guidance on: • depth • context • exemplification.	Learning outcomes that will only be assessed in the Higher Tier paper. The use of bullet points provides guidance on: • depth • context • exemplification.

It may be necessary to teach the content of the Foundation Tier only column to provide the underpinning knowledge required by Higher Tier candidates.

Candidates who are following this specification should have underpinning knowledge of biology through familiarity with the biology content of the Key State 3 programme of study within the National Curriculum.

3.3 Fundamental Scientific Processes

Fundamental Scientific Processes

Item Sa: How Science Works

Summary: In addition to knowledge of the scientific explanations that are detailed in sections 3.4 – 3.9 below, candidates require an understanding of the fundamental scientific processes that underpin these explanations.

Links to other items	Assessable learning outcomes Foundation Tier only: low demand
B3a, B3b, B4d, B5b	Describe a simple scientific idea using a simple model.
B1h, B2f, B4b, B5b	Identify two different scientific views or explanations of scientific data.
B2e, B2f, B3a, B4b	Recall that scientific explanations (hypotheses) are: • used to explain observations • tested by collecting data/evidence.
B2f, B3a, B4b, B5b	Describe examples of how scientists use a scientific idea to explain experimental observations or results.
B2f	Recognise that scientific explanations are provisional but more convincing when there is more evidence to support them.
B1b, B1c, B2f, B2g, B3g, B4g, B5h, B6d	Identify different views that might be held regarding a given scientific or technological development.
B1h, B2e, B2g, B3f, B3g, B3h, B4g, B5g, B5h, B6d, B6h	Identify how a scientific or technological development could affect different groups of people or the environment.
B1a, B1b, B1c, B2g, B1h, B3g, B3h, B5g	Describe risks from new scientific or technological advances.
B2g, B4b	Distinguish between claims/opinions and scientific evidence in sources.
B2f, B3a	Recognise the importance of the peer review process in which scientists check each other's work.
B1a, B1b, B1c, B1e, B2b, B2d, B3c, B3f, B4a, B5d, B5h, B6f	Present data as tables, pie charts or line graphs, identify trends in the data, and process data using simple statistical methods such as calculating a mean.
B1a, B1e, B4a, B5h	Explain how a conclusion is based on the scientific evidence which has been collected.

Fundamental Scientific Processes

Summary (cont.): Studying these processes will provide candidates with an understanding of:

- how scientific explanations have been developed,
- their limitations, and
- how they may impact on individuals and society.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain a scientific process, using ideas or models.	Explain a complex scientific process, using abstract ideas or models.
Describe (without comparing) the scientific evidence that supports or refutes opposing scientific explanations.	Evaluate and critically compare opposing views, justifying why one scientific explanation is preferred to another.
Explain how a scientific idea has changed as new evidence has been found.	Identify the stages in the development of a scientific theory in terms of the way the evidence base has developed over time alongside the development of new ways of interpreting this evidence.
Describe examples of how scientists plan a series of investigations/make a series of observations in order to develop new scientific explanations.	Understand that unexpected observations or results can lead to new developments in the understanding of science.
Recognise that scientific explanations are provisional because they only explain the current evidence and that some evidence/observations cannot yet be explained.	Recognise that confidence increases in provisional scientific explanations if observations match predictions, but this does not prove the explanation is correct.
Explain how the application of science and technology depends on economic, social and cultural factors.	Describe the ways in which the values of society have influenced the development of science and technology.
Identify some arguments for and against a scientific or technological development, in terms of its impact on different groups of people or the environment.	Evaluate the application of science and technology, recognising the need to consider what society considers right or wrong, and the idea that the best decision will have the best outcome for the majority of the people involved.
Suggest ways of limiting risks and recognise the benefits of activities that have a known risk.	Analyse personal and social choices in terms of a balance of risk and benefit.
Evaluate a claim/opinion in terms of its link to scientific evidence.	Evaluate critically the quality of scientific information or a range of views, from a variety of different sources, in terms of shortcomings in the explanation, misrepresentation or lack of balance.
Explain how publishing results through scientific conferences and publications enables results to be replicated and further evidence to be collected.	Explain the value of using teams of scientists to investigate scientific problems.
Choose the most appropriate format for presenting data, and process data using mathematical techniques such as statistical methods or calculating the gradients of graphs.	Identify complex relationships between variables, including inverse relationships, using several mathematical steps. Use range bars and understand their significance for data sets.
Determine the level of confidence for a conclusion based on scientific evidence and describe how further predictions can lead to more evidence being obtained.	Identify and critically analyse conflicting evidence, or weaknesses in the data, which lead to different interpretations, and explain what further data would help to make the conclusion more secure.

3.4 Module B1: Understanding Organisms

Module B1: Understanding Organisms

Item B1a: Fitness and health

Summary: This item looks at the differences between health and fitness, concentrating on the causes and prevention of heart disease, which is the most common cause of death in the UK.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Measure blood pressure.	Explain why blood in arteries is under pressure: • due to contraction of heart muscles • so that it reaches all parts of the body.
Visit a fitness centre, or have a visit from a representative and prepare a report on an individual fitness programme, including how ICT is used in assessing and monitoring fitness.	
Use websites to plan for a lower cholesterol intake. Produce a poster or leaflet encouraging a healthy lifestyle to reduce the risk of heart disease.	Recognise that the risk of developing heart disease can be increased by a number of factors, to include: • high blood pressure • smoking • eating high levels of salt • eating high levels of saturated fat. Describe how cholesterol can restrict or block blood flow in arteries by forming plaques. Analyse data that show the changing incidence of heart disease in the UK.

Module B1: Understanding Organisms

Item B1a: Fitness and health

Links to other items: B1b: Human health and diet, B1e: Drugs and you, B3c: Respiration, B3e: The circulatory system, B5c: Running repairs

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall that blood pressure measurements consist of diastolic and systolic data in mmHg. Describe the factors that increase blood pressure: • being overweight • stress • high alcohol intake • smoking. Describe the factors that decrease blood pressure: • regular exercise • balanced diet.	Explain the possible consequences of having high blood pressure. Explain the possible consequences of having low blood pressure.
Explain the difference between fitness (the ability to do physical activity) and health (free from disease). Analyse the results of different ways of measuring fitness (strength, stamina, flexibility, agility, speed and cardiovascular efficiency).	Evaluate different ways of measuring fitness.
Explain how smoking increases blood pressure: • carbon monoxide reduces the oxygen-carrying capacity of the blood so heart rate increases to compensate • nicotine increases heart rate. Explain how diet can increase the risk of heart disease to include: • saturated fats leading to a build up of cholesterol (a plaque) in arteries • high levels of salt elevating blood pressure. Interpret data showing possible links between the amount of saturated fat eaten, the build up of cholesterol plaques and the incidence of heart disease.	Explain why carbon monoxide reduces the carrying capacity of red blood cells, using the idea that it combines with the haemoglobin preventing the oxygen transport. Explain how narrowed coronary arteries, together with a thrombosis, increase the risk of a heart attack.

Module B1: Understanding Organisms

Item B1b: Human health and diet

Summary: The populations of many countries are either underweight and starving or obese with associated health problems. This item looks at food as a source of energy and raw materials and considers the effects of diet on candidates' bodies. This item provides the opportunity to collect and analyse scientific data from primary and secondary sources, including the use of ICT tasks, when investigating individuals' energy intake and countries facing food emergencies. Research on countries having food emergencies provides the opportunity to discuss ethical issues raised by science and technology.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Compare the nutritional value of various breakfast cereals. Record a day's food intake and calculate the total energy intake. Investigate energy content in various foods. Carry out simple food tests on a variety of food types.	Explain why a balanced diet should include: • protein • carbohydrates and fats • minerals (limited to iron) • vitamins (limited to vitamin C) • fibre • water.
Use ICT tasks, including video clips, to research countries having food emergencies and facing starvation. Calculate personal estimated average daily requirement (EAR) for protein. Record a day's food intake and calculate the amount of protein. Calculate a Body Mass Index (BMI) and use provided information to make a decision as to what it indicates.	Interpret simple data on diet. Explain why: • a high protein diet is necessary for teenagers • in many parts of the world diets are deficient in protein. Recall that proteins are only used as an energy source when fats or carbohydrates are unavailable. Recall that being very overweight (obese) is linked to increased health risks, to include arthritis, heart disease, diabetes and breast cancer.

Module B1: Understanding Organisms

Item B1b: Human health and diet

Links to other items: B1a: Fitness and health, B1e: Drugs and you, B3b: Proteins and mutations, B5c: Running repairs, B5d: Respiratory systems

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall that: • carbohydrates are made up of simple sugars such as glucose • fats are made up of fatty acids and glycerol • proteins are made up of amino acids. Explain how a balanced diet will vary depending on age, gender, activity, religion, personal choice (to include vegetarians and vegans) and medical issues (to include food allergies).	Describe the storage of biological molecules, to include: • carbohydrates are stored in the liver as glycogen or converted to fats • fats are stored under the skin and around organs as adipose tissue • proteins are not stored.
Explain why protein deficiency (kwashiorkor) is common in developing countries, limited to: • overpopulation • limited investment in agricultural techniques. Calculate the estimated average daily requirement (EAR) for protein using the formula: EAR in g = 0.6 × body mass in kg Calculate the Body Mass Index given the formula: BMI = mass in kg/(height in m)^2 and use it as a guide to understand the terms underweight, normal, overweight and obese. Explain how low self-esteem, poor self-image and desire for perfection can lead to a poor diet and the increased risks involved.	Explain why vegetarians need to eat proteins from a wide range of sources compared to people who eat proteins of animal origin. Understand that the EAR is an estimated daily figure for an average person of a certain body mass. Explain why the EAR for protein may vary depending on age, pregnancy and lactation.

Module B1: Understanding Organisms

Item B1c: Staying healthy

Summary: This item aims to help candidates understand the causes, preventative measures and cures of some diseases, while understanding that not all diseases are easily controlled or cured. This item provides the opportunity to analyse, interpret, apply and question scientific information and ideas, including some questions that science cannot currently answer in cancer treatment and drug testing. These topics also allow candidates to discuss ethical issues raised and develop the skills of scientific argument and presentation of data.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out a survey of diseases suffered by candidates in a class or year (limited to flu/colds, athlete's foot and 'stomach upsets') using primary or secondary sources. Case studies involving malaria.	Recall that infectious diseases are caused by pathogens (disease-causing microorganisms). Recall one example of a disease caused by each type of pathogen limited to athlete's foot (fungi), flu (viruses), cholera (bacteria) and malaria (protozoa).
	Describe how the human body is defended against pathogens: • skin provides a barrier • blood clotting prevents entry of pathogens • pathogens are trapped by mucus in airways • hydrochloric acid in the stomach kills pathogens. Describe the difference between infectious and non-infectious diseases. Understand that some disorders have other causes, to include genetic causes.
Chart the immunisation programme recommended in the UK for children up to the age of 16. Carry out the role-playing exercise and data analysis from SATIS 9: The Chinese Cancer Detectives. Use a world map to plan holidays and estimate the risk of exposure to diseases such as malaria, cholera, hepatitis, polio and typhoid.	Recall that immunisation (vaccination) gives protection from certain pathogens. Describe how pathogens that enter the body are destroyed by the immune system (white blood cells): • engulfed by white blood cells • destroyed by antibodies. Interpret data on the incidence of disease around the world to show links with climate and socio-economic factors.
	Explain why new medical treatments/drugs are tested before use.

Module B1: Understanding Organisms

Item B1c: Staying healthy

Links to other items: B3b Proteins and mutations, B6a Understanding microbes, B6b Harmful microorganisms

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall the meaning of the terms parasite and host with reference to malaria. Describe how vectors spread disease: • limited to mosquito.	Explain how knowledge of the life cycle of a disease and the way in which vectors spread disease can help control infections: • limited to malaria and the mosquito.
Describe changes in lifestyle and diet which may reduce the risk of some cancers.	Describe the difference between benign and malignant tumours. Interpret data on types of cancer and survival/ mortality rates.
Explain how pathogens cause the symptoms of an infectious disease by cell damage or by production of toxins. Recall that antibodies lock on to antigens leading to the death of the pathogens. Explain the difference between passive (receive antibodies) and active immunity (make own antibodies). Recall the difference between antibiotics and antiviral drugs.	Explain how each pathogen has its own antigens so specific antibodies are needed. Explain the process of immunisation (vaccination): • harmless pathogen given which carries antigens • antigens trigger immune response by white blood cells which produce antibodies • immunity remains (memory cells produced). Describe the benefits and risks (possible side effects) associated with immunisation. Explain the need for careful use of antibiotics to prevent the increase of resistant strains such as MRSA.
Describe how new treatments are tested using animals, human tissue and computer models and understand objections to some forms of testing.	Explain why blind and double blind trials are used in testing new drugs against placebos or the best existing treatment.

Module B1: Understanding Organisms

Item B1d: The nervous system

Summary: Our bodies have to respond to changes that happen both inside and outside the body. The nervous system plays a major part in this. This item provides the opportunity to collect and analyse primary scientific data when investigating density of nerve endings in different skin areas and secondary data when researching reaction times in races. Theories and ideas can be tested in the investigation of binocular vision. This item develops safe and accurate work skills, along with analysis of ideas.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment to test ranges of vision using cardboard marked out in degrees or moving outstretched arms forward. Demonstrate binocular vision by bringing pencil points together at arm's length using one then two eyes.	Describe how animals detect changes in their environment (stimuli) using receptors which generate nerve impulses. Name and locate the main parts of the eye: cornea, iris, pupil, lens, retina, optic nerve and blind spot.
Investigate why some animals have binocular vision and others do not.	Explain the advantages and disadvantages of: • monocular vision: wider field of view but poorer judgement of distance • binocular vision: narrower field of view but better judgement of distance.
Carry out a survey on eye defects (candidates wearing glasses/contact lens) or use second hand data, in class or year group. Use colour vision deficiency charts.	Describe the main problems in vision limited to long-sight, short-sight and red-green colour blindness.
Carry out an experiment using blunt needles or forceps to determine the density of nerve endings in different skin areas. Carry out experiments on reaction times using ICT. Research allowable reaction times in races.	Name and locate the main parts of the nervous system, to include: • the central nervous system (CNS) (brain and spinal cord) • the peripheral nervous system. Describe the nerve impulse as an electrical signal that is carried by nerve cells called neurones. Describe reflex actions as fast, automatic and protective responses. Recognise that voluntary responses are under the conscious control of the brain.

Module B1: Understanding Organisms

Item B1d: The nervous system

Links to other items: B1e: Drugs and you, B1g: Controlling plant growth, B2e: Adaptations

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the functions of the main parts of the eye: • cornea – refracts light • iris – controls how much light enters pupil • lens – focuses light on to retina • retina – contains light receptors, some sensitive to light of different colours • optic nerve – carries impulses to the brain. Describe the pathway of light through the eyeball, being refracted by the cornea and lens and brought to focus on the retina.	Explain how the eye focuses light (accommodation) from near and distant objects.
Explain how binocular vision helps to judge distances by comparing the images from each eye – the more similar the images, the further away the object.	
Explain how long and short-sight is caused by the eyeball or the lens being the wrong shape. Explain a cause of red-green colour blindness as the lack of specialised cells in the retina.	Explain how long and short-sight can be corrected by corneal surgery or by different lenses in glasses or contact lenses.
Name and locate the parts of a motor neurone: cell body, axon and sheath. Recall that the nerve impulse passes along the axon of a neurone. Describe a reflex arc: stimulus → receptor → sensory neurone → central nervous system → motor neurone → effector → response. Describe the path taken by a spinal reflex involving a receptor, sensory neurone, relay neurone, motor neurone and effector.	Explain how neurones are adapted to their function by their length, insulating sheath and branched endings (dendrites). Recall that the gap between neurones is called a synapse. Describe how an impulse triggers the release of a transmitter substance in a synapse and how it diffuses across to bind with receptor molecules in the membrane of the next neurone causing the impulse to continue.

Module B1: Understanding Organisms

Item B1e: Drugs and you

Summary: Candidates are exposed to many influences that encourage their natural urge to experiment. This item considers the scientific knowledge and explanations of drugs, their effects and the risks involved. Many drugs are also used legitimately and some of these are considered. This item provides the opportunity to find out about the use of contemporary scientific and technological developments in the detection and analysis of different drugs used in sport. Data from secondary sources can be collected and analysed using ICT tools. There is the opportunity to discuss how scientific knowledge and ideas change over time when investigating the link between smoking and lung cancer.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Arrange a visit from the relevant police departments or rehabilitation centres.	Recognise that drugs can be beneficial or harmful. Explain why some drugs are only available on prescription. Explain the terms: addiction, withdrawal symptoms, tolerance and rehabilitation.
Research the drug testing programmes in sport. Research and present information about the effects of different drugs on the body.	Describe the general effects of each drug category: • depressants: slow down brain's activity • pain killers: block nerve impulses • stimulants: increase brain's activity • performance enhancers: muscle development • hallucinogens: distort what is seen and heard.
Carry out the smoking machine experiment to compare high, medium and low tar brands. Research a time line of the link between smoking and lung cancer. Discuss the current anti-smoking laws.	Recall that tobacco smoking can cause emphysema, bronchitis, cancer (mouth, throat, oesophagus and lung) and heart disease. Describe the effects of: • carbon monoxide (lack of oxygen, heart disease) • nicotine (addictive) • tars (irritant, carcinogenic) • particulates (accumulation in lung tissue).
Produce a poster to warn drivers about the dangers of drink driving.	Recognise the short term and long term effects of alcohol on the body: • short term (impaired judgment, balance and muscle control, blurred vision, slurred speech, drowsiness and increased blood flow to the skin) • long term effects (liver and brain damage). Explain why there is a legal limit for the level of alcohol in the blood/breath for drivers and pilots.

Module B1: Understanding Organisms

Item B1e: Drugs and you

Links to other items: B1a: Fitness and health, B1b: Human health and diet, B1d: The nervous system, B5d: Respiratory systems, B5f: Waste disposal

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the basis of the legal classification of drugs: • Class A being the most dangerous with the heaviest penalties • Class C being the least dangerous with the lightest penalties.	
Recall examples of drugs: • depressants, limited to alcohol, solvents and temazepam • pain killers, limited to aspirin and paracetamol • stimulants, limited to nicotine, ecstasy and caffeine • performance enhancers, limited to anabolic steroids • hallucinogens, limited to LSD.	Explain the action of depressants and stimulants on the synapses of the nervous system: • depressants bind with receptor molecules in the membrane of the next neurone blocking the transmission of the impulses • stimulants cause more neurotransmitter to cross the synapse.
Describe how cigarette smoke affects ciliated epithelial cells lining the trachea, bronchi and bronchioles. Explain why damage to ciliated epithelial cells can lead to a 'smokers cough'.	Evaluate data on the effects of smoking in populations (to include, cancer, heart disease, emphysema and birth weights of babies born to mothers who smoke).
Interpret data on the alcohol content (measured in units of alcohol) of different alcoholic drinks. Interpret information on reaction times, accident statistics and alcohol levels.	Describe how the liver can become damaged as it removes alcohol (cirrhosis), to include: • enzymes in liver breakdown alcohol • toxic products of alcohol breakdown cause liver damage

Module B1: Understanding Organisms

Item B1f: Staying in balance

Summary: Many complex chemical processes take place in our cells and organs to ensure an optimum state. This item looks at how a constant internal environment is achieved. This item provides the opportunity to collect and analyse primary data and present information using scientific and mathematical conventions in the 'changing skin temperatures' experiment. The use of a data logger can provide an opportunity to use an ICT tool. Discussing the use of thermal blankets as a contemporary application of science, along with work on heat stroke, provides the opportunity to look at the benefits of technological developments.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Discuss automatic control systems in candidates' lives e.g. central heating, air conditioning, cruise control in cars, incubators.	Recognise that the body works to maintain steady levels of temperature, water, and carbon dioxide and that this is essential to life.
Carry out an experiment on the changing skin temperature down an arm or a leg and plot the results accurately on a graph. Measure body temperature using a range of different procedures. Discuss the use of thermal first aid blankets after activities such as marathons. Produce a poster warning older people about hypothermia and telling them how to prevent it.	Recall that the core temperature of the human body is normally maintained at approximately 37°C. Describe appropriate procedures to measure body temperature: • where (ear, finger, mouth, or anus) • how (using a clinical thermometer, sensitive strips, digital recording probes, or thermal imaging). Describe how heat can be gained or retained (by respiration, shivering, exercise, less sweating, less blood flow near skin surface, or clothing). Describe how more heat can be lost (by sweating, or more blood flow near skin).
Research diabetes and how it can be managed. www.abpischools.org.uk	Name and locate the pancreas. Recall that the pancreas produces the hormone insulin. Recall that Type 1 diabetes is caused by the failure of the pancreas to produce insulin. Describe how insulin travels around the body.

Module B1: Understanding Organisms

Item B1f: Staying in balance

Links to other items: B2e: Adaptations, B5f: Waste disposal

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand that maintaining a constant internal environment involves balancing bodily inputs and outputs and is called homeostasis. Explain why factors are kept at steady levels by automatic control systems (limited to temperature, water content and carbon dioxide).	Explain how negative feedback mechanisms are used to maintain a constant internal environment.
Explain how sweating increases heat transfer to the environment by evaporation of sweat which requires heat, so removing heat from the skin. Understand that the body temperature of 37°C is the optimum temperature for the action of many enzymes. Describe how high temperatures can cause heat stroke and dehydration and if untreated, death. Describe how very low temperatures can cause hypothermia and if untreated, death.	Explain how vasodilation and vasoconstriction increase or reduce heat transfer to the environment. Understand that the body temperature of 37°C is linked to enzyme action. Explain how blood temperature is monitored by the brain which will bring about temperature control mechanisms via the nervous and hormonal systems.
Recall that insulin controls blood sugar levels. Explain how Type 2 diabetes can often be controlled by diet but that Type 1 diabetes also needs to be treated by insulin dosage. Explain why responses controlled by hormones are usually slower than responses controlled by the nervous system.	Explain how insulin helps to regulate blood sugar levels. Explain how the dosage of insulin needed to be taken by a person with Type 1 diabetes depends upon diet and activity.

Module B1: Understanding Organisms

Item B1g: Controlling plant growth

Summary: Growth and development in plants are controlled by plant growth regulators (hormones). This item examines some examples of this, as well as how humans can use plant hormones to aid the efficient production of food. Experiments on seed growth allow the development of safe and accurate working, the presenting of results and evaluation of data collection and the quality of the data.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment to test whether cress seedlings grow towards light. Carry out an experiment to test whether bean roots always grow downwards. Use ICT to watch and compare time lapse videos of plant tropisms.	Recognise that plants as well as animals respond to changes in their environment. Understand that plant growth (limited to growth of shoots and roots, flowering and fruit ripening) is controlled by chemicals called plant hormones. Describe an experiment to show that shoots grow towards light. Understand how growth towards light increases the plant's chance of survival. Understand why roots grow downwards.
Take cuttings using rooting powder to encourage root growth. Research how seedless grapes are produced. Investigate bananas ripening more quickly if already-ripened bananas are close by; research why this happens.	Recognise that plant hormones can be used in agriculture to speed up or slow down plant growth.

Module B1: Understanding Organisms

Item B1g: Controlling plant growth

Links to other items: B1d: The nervous system, B4c: Leaves and photosynthesis, B4h: Farming

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe shoots as positively phototropic but negatively geotropic. Describe roots as negatively phototropic but positively geotropic. Recall that the group of plant hormones called auxins: • move through the plant in solution • are involved in the response to light (phototropism) • are involved in the response to gravity (geotropism).	Interpret data from phototropism experiments in terms of auxin action: • auxin made in tip • unequally distributed in response to light. Explain how auxin brings about shoot curvature in terms of cell elongation.
Relate the action of plant hormones to their commercial uses: • selective weedkillers • rooting powder • fruit ripening (delay or acceleration) • control of dormancy.	

Module B1: Understanding Organisms

Item B1h: Variation and inheritance

Summary: This item looks at the causes of variation and how we can use our knowledge of inheritance to help predict the characteristics of children.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Use poppit beads to show combinations due to chance. Toss coins to show expected and 'real' ratios. Use a genetics kit to show the results of a monohybrid cross. Debate the arguments for and against parents knowing a baby's gender before birth.	Analyse human characteristics to determine those that are a result of both environmental and inherited factors, to include: • intelligence • body mass • height. Recall that chromosomes are held in the nucleus and that they carry information in the form of genes, which control inherited characteristics. Recognise that most body cells contain chromosomes in matched pairs. Recall that gametes have half the number of chromosomes of body cells.
	Recognise that some disorders are inherited: red-green colour blindness, sickle cell anaemia and cystic fibrosis.

Module B1: Understanding Organisms

Item B1h: Variation and inheritance

Links to other items: B2a: Classification, B2f: Natural selection, B3a: Molecules of life, B3d: Cell division, B5g: Life goes on

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Identify inherited characteristics as dominant or recessive when given the results of a breeding experiment. Explain the causes of genetic variation, to include: • mutations (changes to the genes) • gamete formation • fertilisation. Recall that most body cells have the same number of chromosomes but this number varies between species (humans have 23 pairs). Recall that alleles are different versions of the same gene. Describe how sex (in mammals) is determined by sex chromosomes: XX (female) and XY (male).	Understand the debate over the relative importance of genetic and environmental factors in determining some human attributes: intelligence, sporting ability and health. Explain how dominant and recessive characteristics depend on dominant and recessive alleles: • dominant alleles are those expressed if present • recessive alleles are those only expressed if the dominant allele is absent. Explain a monohybrid cross involving dominant and recessive alleles using genetic diagrams with letters representing alleles. Use and explain genetic terms: • homozygous – two identical alleles • heterozygous – two different alleles • genotype – the genetic makeup • phenotype – the characteristics expressed. Explain sex inheritance, including the production of equal numbers of male and female offspring, using genetic diagrams.
Understand that inherited disorders are caused by faulty genes. Understand the issues raised by knowledge of inherited disorders in a family.	Recall that inherited disorders are caused by faulty alleles, most of which are recessive. Use genetic diagrams to predict the probabilities of inherited disorders passing to the next generation.

3.5 Module B2: Understanding Our Environment

Module B2: Understanding Our Environment

Item B2a: Classification

Summary: We are surrounded by a huge variety of living organisms. Through classifying them according to their similarities and differences, we can better understand the evolutionary and ecological relationships between living organisms. The ability to correctly classify organisms is crucial if we are to identify and maintain global biodiversity.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Place different organisms into groups.	Understand that organisms can be classified into groups according to shared characteristics. Describe the characteristics used to place organisms into the five Kingdoms.
Collect invertebrates from local surroundings and develop a simple key. Use a simple key to identify some invertebrates.	Use characteristics to place organisms into the different classes of arthropod, limited to: • insects • arachnids • crustaceans • myriapods.
Research the work of John Ray and Carl Linnaeus in developing a modern classification system.	Recognise that organisms of the same species: • may show great variation • have more features in common than they do with organisms of a different species.
	Understand why similar species tend to live in similar types of habitats.

Module B2: Understanding Our Environment

Item B2a: Classification

Links to other items: B1h: Variation and inheritance, B2f: Natural selection, B4a: Ecology in the local environment, B6a: Understanding microbes

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand that the variety of life is a continuous spectrum which makes it difficult to place organisms into distinct groups. Describe the classification of organisms into kingdom, phylum, class, order, family, genus and species. Explain the importance of classification of species in terms of identifying evolutionary and ecological relationships.	Describe classification systems to include natural (based on evolutionary relationships) and artificial (for purposes of identification). Explain how the use of DNA sequencing information has led to changes in understanding of classification. Understand why systems of classification change over time.
Understand that the evolutionary relationships between organisms can be displayed using evolutionary trees.	Understand how the evolutionary relationships of organisms in a group can be modelled by analysing multiple characteristics and how this has been facilitated by ICT.
Define the term 'species' as a group of organisms which are capable of interbreeding to produce fertile offspring. Explain the importance of the binomial system as the international basis of naming species.	Explain some of the problems of classifying organisms into species, to include: • hybrids • organisms that only reproduce asexually • evolution as a continuing process.
Recall that closely related species: • share a relatively recent ancestor • may have different features if they live in different types of habitats.	Explain how similarities and differences between species can be explained in terms of both evolutionary and ecological relationships.

Module B2: Understanding Our Environment

Item B2b: Energy flow

Summary: All living things need energy to live. Ultimately this energy comes from the Sun. This item explains how energy from the Sun flows through ecosystems and how humans can harness it. The work on energy transfer provides the opportunity to examine the ethical issues raised by decisions on plant use and the environmental effects of such decisions.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Research food chains in different habitats.	Explain the term trophic level. Understand that there are organisms other than green plants that are producers. Explain why some organisms are both primary and secondary consumers. Explain how changes in the population of one organism may affect the other organisms in a food web.
Survey peers on vegetarian diet. Consider and compare sources of food.	Explain how energy from the Sun flows through food webs. Interpret data on energy flow in food webs.

Module B2: Understanding Our Environment

Item B2b: Energy flow

Links to other items: B2c: Recycling, B2d: Interdependence, B4b: Photosynthesis, B6c: Useful microorganisms, B6f: Microscopic life in water

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand how pyramids of biomass show the dry mass of living material at each stage of a food chain. Construct pyramids of biomass from given information. Explain why pyramids of numbers and pyramids of biomass for the same food chains can be different shapes.	Explain the difficulties in constructing pyramids limited to: • organisms may belong to more than one trophic level • the problems with measuring dry biomass.
Explain how some energy is transferred to less useful forms at each stage (trophic level) in the food chain, to include: • heat from respiration • excretion • egestion. Describe how excretory products, faeces and uneaten parts can be used as the starting point for other food chains.	Explain how the efficiency of energy transfer explains the shape of pyramids of biomass. Explain how the efficiency of energy transfer explains the limited length of food chains. Calculate the efficiency of energy transfer.

Module B2: Understanding Our Environment

Item B2c: Recycling

Summary: We are encouraged to recycle to save the Earth's resources, but natural recycling is nothing new. The survey of local recycling schemes provides the opportunity to use ICT sources and tools to collect secondary data.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey of local recycling schemes. Compare local recycling schemes with national and international recycling schemes. Composting activities. Observation/measurement of leaf decomposition in hedges.	Recall that when animals and plants die and decay the elements in their bodies are recycled. Recognise that many soil bacteria and fungi are decomposers, which decay dead organisms. Describe the importance of this decay process in making elements available again to living organisms. Recognise that as animals and plants grow they take in chemicals and incorporate elements from these into their bodies. Recall that two of the most important elements that are required are: • carbon • nitrogen. Recall that carbon is taken up by plants as carbon dioxide.
Carry out an experiment to test soil for nitrates. Examine clover roots to see nodules. Make a nitrogen cycle snakes and ladders game. Investigate nitrogen fixing bacteria (see Practical Microbiology for Secondary Schools).	Recall that nitrogen is taken up by plants as nitrates. Recall the abundance of nitrogen in the air (78%). Explain why nitrogen gas cannot be used directly by animals or plants, in terms of its reactivity.

Module B2: Understanding Our Environment

Item B2c: Recycling

Links to other items: B2b: Energy flow, B3c: Respiration, B4b: Photosynthesis, B4f: Plants need minerals, B4g: Decay, B4h: Farming, B6e: Life in soil

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain why recycling of nutrients takes longer in waterlogged or acidic soils than it does in well drained neutral soils. Explain how carbon is recycled in nature, limited to: • plants removing carbon dioxide from the air by photosynthesis • feeding passes carbon compounds along a food chain or web • plants and animals releasing carbon dioxide into the air, as a product of respiration • burning of fossil fuels (combustion) releasing carbon dioxide • soil bacteria and fungi, acting as decomposers, releasing carbon dioxide into the air.	Explain how carbon is recycled in nature, limited to: • marine organisms making shells made of carbonates • shells becoming limestone • carbon returning to the air as carbon dioxide during volcanic eruption or weathering • oceans absorbing carbon dioxide, acting as carbon sinks.
Explain how nitrogen is recycled in nature, limited to: • plants taking in nitrates from the soil to make protein for growth • feeding passes nitrogen compounds along a food chain or web • nitrogen compounds in dead plants and animals being broken down by decomposers and returning to the soil.	Explain how nitrogen is recycled in nature, limited to: • soil bacteria and fungi, acting as decomposers, converting proteins and urea into ammonia • the conversion of this ammonia to nitrates by nitrifying bacteria • the conversion of nitrates to nitrogen gas by denitrifying bacteria • the fixing of nitrogen gas by nitrogen-fixing bacteria living in root nodules or in the soil, or by the action of lightning.

Module B2: Understanding Our Environment

Item B2d: Interdependence

Summary: This item seeks to help candidates understand that there is a struggle for existence and the survival of animals and plants depends on how they cope with competition and predation. There are also other types of interdependence to include parasitism and organisms co-existing to their mutual benefit.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey a habitat and produce a display to show the plants/animals competing in the habitat. For example, why are 'weeds' successful competitors? Research invasive species, for example Himalayan balsam, Japanese knotweed and American crayfish.	Explain how competition may influence the distribution and population size of animals or plants, related to the availability of food, water, shelter, light and minerals. Interpret data which shows that animals and plants can be affected by competition for resources, including population sizes and distribution data.
	Explain how the size of a predator population will affect the numbers of prey and vice versa.
Examine root nodules using a hand lens. Research examples of mutualism and other associations between organisms. Research how parasites are adapted to survive in/on their particular hosts.	Recall that some organisms benefit from the presence of organisms of a different species. Describe one example of such a relationship, limited to cleaner species, to include oxpecker and buffalo.

Module B2: Understanding Our Environment

Item B2d: Interdependence

Links to other items: B2b: Energy flow, B2c: Recycling, B2e: Adaptations, B2f: Natural selection

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how similar animals in the same habitat will be in close competition. Describe how organisms within a species compete in order to survive and breed.	Use the terms interspecific and intraspecific to describe given examples of competition and explain why intraspecific competition is often more significant. Explain what is meant by the term ecological niche. Understand that similar organisms will occupy similar ecological niches.
Explain how the populations of some predators and their prey show cyclical fluctuations in numbers.	Explain why the cycles of population for predator and prey are out of phase with each other.
Describe other types of interdependence between organisms to include: • parasitism, where the parasite benefits to the living host's detriment, including fleas and tapeworms • mutualism, where both species benefit including cleaner species and pollination by insects.	Explain how the interdependence of organisms determines their distribution and abundance. Explain why nitrogen-fixing bacteria in the root nodules of leguminous plants are an example of mutualism.

Module B2: Understanding Our Environment

Item B2e: Adaptations

Summary: Our environment is constantly changing. This affects animal and plant distributions. This item develops ideas about how some plants and animals successfully adapt to suit their changing environment.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Using a hand lens, observe a worm and list all of its adaptations that make it successful for life in the soil. Make a model of a plant and discuss the adaptations that make it successful. Research organisms that have lost/reduced features that are no longer required e.g. blind cave fish that have lost eyes. Carry out an internet search to find pictures of animals or plants with successful camouflage and other adaptations. Identify predators and discuss the adaptations that will make them successful. Use ICT to make a poster to explain how an organism is adapted to its habitat.	Explain how some animals are adapted to be successful predators, to include: • binocular vision to judge distance and size • hunting strategy • breeding strategy. Explain how some animals are adapted to avoid being caught as prey, to include: • eyes on side of head for wide field of view • living in groups (herds or shoals) to reduce the chance of being caught • cryptic and warning colouration • mimicry • breeding strategy (synchronous breeding).
Discuss possible climate changes and predict which animals and plants will successfully adapt to survive in the new conditions.	Recall that animals and plants that are adapted to their habitats are better able to compete for limited resources.

Module B2: Understanding Our Environment

Item B2e: Adaptations

Links to other items: B2d: Interdependence, B2f: Natural selection, B3e: The circulatory system, B3g: New genes for old, B4a: Ecology in the local environment, B4c: Leaves and photosynthesis, B4d: Diffusion and osmosis, B4e: Transport in plants, B5d: Respiratory systems, B5e: Digestion

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how adaptations to cold environments help organisms survive, to include: • anatomical methods of reducing heat loss, including insulation and surface area • behavioural adaptations, including migration and hibernation. Explain how adaptations to hot environments help organisms survive to include: • behavioural and anatomical methods of increasing heat loss • behavioural methods of reducing heat gain. Explain how adaptations to dry environments help organisms survive to include: • behavioural, anatomical and physiological methods for coping with lack of water.	Analyse surface area to volume ratios in the context of different environmental stresses. Explain how counter-current heat exchange systems (e.g. in penguins) minimise heat loss. Understand that some organisms are biochemically adapted to extreme conditions, including different optimum temperatures for enzymes in extremophiles and organisms with antifreeze proteins.
Explain how animals and plants that are adapted to an environment are better able to compete for limited resources.	Describe how some organisms are: • specialists, which are well suited to only certain habitats • generalists, which can live in a range of habitats but can easily be out-competed.

Module B2: Understanding Our Environment

Item B2f: Natural selection

Summary: The concept of evolution is well known. However, the mechanism of evolution by natural selection is commonly misunderstood. This item discusses evidence for evolution as well as its mechanism. It also looks at how scientific theories develop and why some become accepted and some do not.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Draw a poster to show how natural selection takes place. Design a newspaper article telling people about Charles Darwin's observations and theories. Research the role of Alfred Russell Wallace in developing the theory of natural selection. Research Charles Darwin and his voyages. Plot the distribution of the peppered moth on a map showing major cities. Research resistant bacteria and discuss the problems they cause in hospitals. Research species that do not appear to have evolved but have stayed as they are for millions of years, so called 'living fossils', e.g. coelacanth, crocodiles, sharks and Ginkgo and suggest why they do not appear to have changed.	Identify variations within a population of organisms of the same species. Explain why animals and plants that are better adapted to their environment are more likely to survive. Recognise that over long periods of time, groups of organisms can change and that this is called evolution. Understand how when environments change, some animal and plant species survive or evolve but many become extinct.
Research Lamarck and his ideas about evolution.	Recall that: • many theories have been put forward to explain how evolution may occur • most scientists accept the theory of natural selection first put forward by Charles Darwin.

Module B2: Understanding Our Environment

Item B2f: Natural selection

Links to other items: B1h: Variation and inheritance, B2a: Classification, B2d: Interdependence, B2e: Adaptations, B3g: New genes for old, B6e: Life in soil

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand Darwin's theory of evolution by natural selection to include: • presence of natural variation • competition for limited resources • survival of the fittest • inheritance of 'successful' adaptations. Recall that adaptations are controlled by genes and that these genes can be passed on to the next generation.	Explain how over long periods of time the changes brought about by natural selection may result in the formation of new species. Understand why speciation requires geographical or reproductive isolation of populations.
Explain the reasons why the theory of evolution by natural selection met with an initially hostile response (social and historical context). Recognise that natural selection as a theory is now widely accepted: • because it explains a wide range of observations • because it has been discussed and tested by a wide range of scientists.	Explain how Lamarck's idea of evolution by the inheritance of acquired characteristics was different from Darwin's theory. Explain why Lamarck's theory was discredited: his explanation did not have a genetic basis. Recognise that the theory of natural selection has developed as new discoveries have been made, to include the understanding of inheritance.

Module B2: Understanding Our Environment

Item B2g: Population and pollution

Summary: Young people are aware of the increasing human population and how this is related to an increase in pollution levels. The use of living and non-living indicators of pollution are considered.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Plot the increase in population and compare with the increase in a pollutant. Draw a poster to show the percentage of different types of household waste found in the average family dustbin. Investigate the germination of seeds and the growth of seedlings in different levels of acid rain.	Recognise that the human population is increasing. Recognise that the human population uses resources, some of which are finite, to include: • fossil fuels • minerals. Explain how as the human population increases, resource use increases and therefore more pollution is created; pollutants limited to: • household waste • sewage • sulfur dioxide from burning fossil fuels • carbon dioxide from burning fossil fuels.
Research the methods used to measure the increase in levels of carbon dioxide in the past 200 years. Research possible links between the data concerning carbon dioxide levels and global temperatures. Explore impacts of chemicals on plant growth www-saps.plantsci.cam.ac.uk.	Understand that pollution can affect the number and type of organisms that can survive in a particular place.

Module B2: Understanding Our Environment

Item B2g: Population and pollution

Links to other items: B2h: Sustainability, B4a: Ecology in the local environment, B6d: Biofuels

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand that the human population is increasing exponentially. Understand that population growth is the result of the birth rate exceeding the death rate. Explain the causes and consequences of: • global warming • ozone depletion • acid rain.	Explain how the developed countries of the world, with a small proportion of the world's population, have the greatest impact on the use of resources and the creation of pollution. Explain the term 'carbon footprint' in terms of the amount of greenhouse gases given off in a certain period of time. Discuss the possible consequences of exponential growth.
Explain how the presence/absence of indicator species helps to indicate the level of pollution, to include: • water pollution – waterlouse, sludgeworm, rat-tailed maggot and mayfly larva • air pollution – lichen. Describe how pollution can be measured: • by direct measurement of pollutant levels • by measuring the occurrence of indicator species.	Interpret data on indicator species. Describe the advantages and disadvantages of using living and non-living methods of measuring levels of pollution.

Module B2: Understanding Our Environment

Item B2h: Sustainability

Summary: Sustainable development is a term that is becoming more widely used and refers to the economic exploitation of the environment in a way that can be maintained without causing permanent damage. We are also conscious of the damage that has already been done and are trying to protect endangered habitats and species. This item develops ideas about our choices and responsibilities with particular reference to whales.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Make a display of endangered and extinct plants and animals. Research organisms that used to exist in the UK. Use ICT to produce an information leaflet on one endangered species, showing reasons for its predicament and suggestions for its protection, using the IUCN red list. Research the use of seed banks (extinct plants project at Kew).	Explain why organisms become extinct or endangered, to include: • climate change • habitat destruction • hunting • pollution • competition. Describe how endangered species can be conserved, to include: • protecting habitats • legal protection • education programmes • captive breeding programmes • seed banks • creating artificial ecosystems.
Search the internet for information on an endangered species. Class discussion on nature reserves: 'Why should we have zoos/marine parks/nature reserves?'. Plot the distributions of whale species on a world map.	Interpret data which shows that whale species' distributions depend on their feeding habitats. Discuss the reasons why certain whale species are close to extinction.
	Recognise that a sustainable resource can be removed from the environment without it running out. Recall that some resources can be maintained, limited to: • fish stocks • woodland.

Module B2: Understanding Our Environment

Item B2h: Sustainability

Links to other items: B2f: Natural selection, B2g: Population and pollution

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain reasons for conservation programmes, to include: • protecting human food supply • ensuring minimal damage to food chains • future identification of plants for medical purposes • cultural aspects. Explain why species are at risk of extinction if the number of individuals or habitats falls below a critical level.	Explain why species are at risk of extinction if there is not enough genetic variation in the population. Evaluate a given example of a conservation programme in terms of: • genetic variation of key species • viability of populations • available habitats • interaction between species.
Recognise that both living and dead whales have commercial value: tourism when alive; food, oil and cosmetics when dead. Describe issues arising from keeping whales in captivity: entertainment, research, captive breeding programmes and lack of freedom.	Recognise that some aspects of whale biology are still not fully understood: communication, migration patterns and survival at extreme depths. Describe issues concerning whaling, to include: getting international agreement, policing and enforcing such agreements and hunting for research.
Explain the term 'sustainable development' as providing for the needs of an increasing population without harming the environment. Explain how fish stocks and woodland can be sustained and developed using: • education • quotas on fishing • re-planting of woodland.	Explain the importance of population size, waste products and food and energy demands in the achievement of sustainable development. Understand that sustainability requires planning and co-operation at local, national and international levels. Describe how sustainable development may protect endangered species.

3.6 Module B3: Living And Growing

Module B3: Living And Growing

Item B3a: Molecules of life

Summary: The fundamental processes of life occur inside cells. This item examines the role of DNA in the production of proteins, the building blocks of living things. This item provides the opportunity to explain phenomena using scientific theories, models and ideas. Using the discovery of the structure of DNA it also illustrates the collaborative nature of science and the need for new discoveries to be validated.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Make a stained cheek cell slide and examine it using a microscope.	Identify the mitochondria in an animal cell. Recall that respiration occurs in the mitochondria providing energy for life processes.
Use of 'Cake Workshop': • 'Recipe for life' – an activity to demonstrate use of a recipe (code); See www.bbsrc.ac.uk. Examine a model of DNA. Carry out role playing exercise to demonstrate base pairings. Research the Human Genome Project and efforts to sequence the genome of other organisms.	Recall that chromosomes in the nucleus: • carry coded information in the form of genes • are made of a molecule called DNA. Recall that the information in genes is in the form of coded instructions called the genetic code. Understand that the genetic code controls cell activity and consequently some characteristics of the organism. Recall that DNA controls the production of different proteins. Recall that proteins are needed for the growth and repair of cells.
Research the roles of Watson, Crick and others in increasing our understanding of the structure of DNA.	Recall that the structure of DNA was first worked out by two scientists called Watson and Crick.

Module B3: Living And Growing

Item B3a: Molecules of life

Links to other items: B1h: Variation and inheritance, B3b: Proteins and mutations, B3d: Cell division, B3g: New genes for old, B6h: Gene technology

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain why liver and muscle cells have large numbers of mitochondria.	Recall that: • some structures in cells, such as ribosomes, are too small to be seen with the light microscope • ribosomes are in the cytoplasm and are the site of protein synthesis.
Describe the structure of DNA as two strands coiled to form a double helix, each strand containing chemicals called bases, of which there are four different types, with cross links between the strands formed by pairs of bases. Describe chromosomes as long, coiled molecules of DNA, divided up into regions called genes. Recall that each gene: • contains a different sequence of bases • codes for a particular protein. Recall that proteins are made in the cytoplasm and understand why a copy of the gene is needed: the gene itself cannot leave the nucleus.	Recall that the four bases of DNA are A, T, C and G (full names will not be required). Describe the complementary base pairings: A – T and G – C. Explain how protein structure is determined by the DNA base code, to include: • the base sequence determines amino acid sequence • each amino acid is coded for by a sequence of 3 bases. Explain how the code needed to produce a protein is carried from the DNA to the ribosomes by a molecule called mRNA. Explain how DNA controls cell function by controlling the production of proteins, some of which are enzymes.
Describe how Watson and Crick used data from other scientists to build a model of DNA, to include: • X-ray data showing that there were two chains wound in a helix • data indicating that the bases occurred in pairs.	Explain why new discoveries, such as Watson and Crick's, are not accepted or rewarded immediately, to include: • the importance of other scientists repeating or testing the work.

Module B3: Living And Growing

Item B3b: Proteins and mutations

Summary: The genetic material in the form of DNA codes for the production of proteins. This item looks at the structure and functions of proteins in living organisms, including the role of enzymes. It also introduces mutations and how they can alter the proteins that a cell produces. The study of enzyme action provides the opportunity to gain the skills of working accurately and safely, individually and with others, to collect first-hand data and to test a scientific explanation using scientific theories, models and ideas.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
	Recall some examples of proteins to include: • collagen • insulin • haemoglobin.
Build plasticine models to illustrate the 'lock and key' mechanism. Investigate the effects of changing temperature or pH on enzyme activity.	Describe enzymes as: • proteins • molecules that speed up a chemical reaction • working best at a particular temperature. Understand that enzymes have active sites that substrate molecules fit into when a reaction takes place.
	Recognise that different cells and different organisms will produce different proteins. Describe gene mutations as changes to genes.

Module B3: Living And Growing

Item B3b: Proteins and mutations

Links to other items: B1b: Human health and diet, B1c: Staying healthy, B1h: Variation and inheritance, B3a: Molecules of life, B5e: Digestion, B6g: Enzymes in action

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recognise that proteins are made of long chains of amino acids. Describe some functions of proteins, to include: • structural (limited to collagen) • hormones (limited to insulin) • carrier molecules (limited to haemoglobin) • enzymes.	Explain how each protein has its own number and sequence of amino acids, which results in differently shaped molecules, which have different functions.
Describe enzymes as: • biological catalysts • catalysing chemical reactions occurring in living cells: respiration, photosynthesis, protein synthesis • having a high specificity for their substrate. Explain the specificity of enzymes in terms of the 'lock and key' mechanism. Describe how changing temperature and pH, away from the optimum, will change the rate of reaction of an enzyme-catalysed reaction.	Explain how enzyme activity is affected by pH and temperature, to include: • lower collision rates at low temperatures • denaturing at extremes of pH and high temperatures • denaturing as an irreversible change inhibiting enzyme function • denaturing changing the shape of the active site. Calculate and interpret the Q_{10} value for a reaction over a 10°C interval, given graphical or numerical data, using the formula: $Q_{10} = \frac{\text{rate at higher temperature}}{\text{rate at lower temperature}}$
Recall that gene mutations may lead to the production of different proteins. Understand that mutations occur spontaneously but can be made to occur more often by radiation or chemicals. Understand that mutations are often harmful but may be beneficial or have no effect.	Understand that only some of the full set of genes are used in any one cell; some genes are switched off. Understand that the genes switched on determine the functions of a cell. Explain how changes to genes alter, or prevent the production of the protein which is normally made.

Module B3: Living And Growing

Item B3c: Respiration

Summary: Respiration is a vital reaction that takes place inside cells. It releases the energy that is needed to drive many other metabolic reactions. This item provides candidates with the opportunity to collect and analyse scientific data concerning respiration rates. They can also gain the skills of working accurately and safely, individually and with others, to collect first-hand data when investigating pulse recovery times.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Use lime water or hydrogen-carbonate indicator to compare rates of respiration.	Recognise that the energy provided by respiration is needed for all life processes in plants and in animals. Recall and use the word equation for aerobic respiration: glucose + oxygen → carbon dioxide + water Describe examples of life processes that require energy from respiration, to include: • muscle contraction • protein synthesis • control of body temperature in mammals.
Carry out a fist clenching exercise with arm raised and then lowered to demonstrate muscle fatigue. Carry out a weight lifting exercise by a finger to show muscle fatigue. Carry out experiments on pulse recovery times and compare data using ICT skills.	Explain why breathing and pulse rates increase during exercise. Describe an experiment to measure resting pulse rate and recovery time after exercise. Analyse given data from a pulse rate experiment.

Module B3: Living And Growing

Item B3c: Respiration

Links to other items: B1a: Fitness and health, B2c: Recycling, B4b: Photosynthesis, B5d: Respiratory systems, B6c: Useful microorganisms

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall and use the symbol equation for aerobic respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ Use data from experiments to compare respiration rates, to include: • increased oxygen consumption • increased carbon dioxide production. Calculate the respiratory quotient (RQ) using the formula (data provided): $RQ = \frac{\text{carbon dioxide produced}}{\text{oxygen used}}$	Recall that respiration results in the production of ATP and that ATP is used as the energy source for many processes in cells. Explain how the rate of oxygen consumption can be used as an estimate of metabolic rate because aerobic respiration requires oxygen. Explain why the rate of respiration is influenced by changes in temperature and pH.
Explain why anaerobic respiration takes place during hard exercise in addition to aerobic respiration. Recall that this produces lactic acid which accumulates in muscles causing pain and fatigue. Recall and use the word equation for anaerobic respiration which releases energy: glucose → lactic acid Understand that anaerobic respiration releases much less energy per glucose molecule than aerobic respiration.	Explain fatigue in terms of lactic acid build up (oxygen debt) and how this is removed during recovery, to include: • hard exercise causing lack of oxygen in cells • the incomplete breakdown of glucose • continued panting replacing oxygen allowing aerobic respiration • increased heart rate ensuring that blood carries lactic acid away to the liver.

Module B3: Living And Growing

Item B3d: Cell division

Summary: As living things grow, the number of cells in them increases. This brings significant advantages, and requires the development of complex organ systems. This item looks at the two ways cells divide, mitosis and meiosis, and the differences between these types of cell division. Software simulations and video clips which show cell division are uses of ICT in teaching and learning.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
	Describe the difference between simple organisms which are unicellular and more complex organisms which are multicellular.
Watch a video, examine photographs and use software simulations of cell division. Use models to illustrate cell division, using wool or plasticine. Examine prepared microscope slides to show cell division. Prepare a stained microscope slide of a root tip squash to show mitosis (e.g. garlic or hyacinth). Use bacterial or yeast growing kits.	Recall that most body cells contain chromosomes in matching pairs. Explain why the chromosomes have to be copied to produce new cells for growth. Recall that this type of cell division is also needed for: • replacement of worn out cells • repair to damaged tissue • asexual reproduction.
Examine bull's sperm using a microscope. Examine a hen's egg to show the large amount of stored food. Examine pollen using a microscope.	Recall that in sexual reproduction gametes join in fertilisation. Recall that gametes have half the number of chromosomes of body cells. Understand that in sexual reproduction to produce a unique individual half the genes come from each parent. Explain why sperm cells are produced in large numbers: to increase the chance of fertilisation.

Module B3: Living And Growing

Item B3d: Cell division

Links to other items: B1h: Variation and inheritance, B3f: Growth and development, B4d: Diffusion and osmosis, B6a: Understanding microbes

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the advantages of being multicellular: • allows organism to be larger • allows for cell differentiation • allows organism to be more complex.	Explain why becoming multicellular requires the development of specialised organ systems, limited to: • communication between cells • supplying the cells with nutrients • controlling exchanges with the environment.
Recall that new cells for growth are produced by mitosis. Explain why these new cells are genetically identical. Recall that in mammals, body cells are diploid (two copies of each chromosome). Explain why DNA replication must take place before cells divide.	Describe how, prior to mitosis, DNA replication occurs, to include: • 'unzipping' to form single strands • new double strands forming by complementary base pairing. Describe how in mitosis the chromosomes: • line up along the centre of the cell • they then divide • the copies move to opposite poles of the cell.
Recall that gametes are produced by meiosis. Describe gametes as haploid (contain one chromosome from each pair). Explain why fertilisation results in genetic variation, limited to: • gametes combine to form a diploid zygote • genes on the chromosomes combine to control the characteristics of the zygote. Explain how the structure of a sperm cell is adapted to its function, to include: • many mitochondria to provide energy • an acrosome that releases enzymes to digest the egg membrane.	Explain why, in meiosis, the chromosome number is halved and each cell is genetically different, to include: • one chromosome from each pair separate to opposite poles of the cell in the first division • chromosomes divide and the copies move to opposite poles of the cell in the second division.

Module B3: Living And Growing

Item B3e: The circulatory system

Summary: The development of larger, multicellular organisms has resulted in the development of complex organ systems. This item describes one of these systems, the circulatory system. It explains why blood is vital for life as it transports materials around the body to and from different cells. Research and presentation of a report on disorders of the blood allows the opportunity to use ICT in teaching and learning to present information using scientific language and conventions.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Research and present a report on disorders of the blood e.g. haemophilia, sickle cell anaemia and leukaemia.	Describe the functions of components of the blood: • red blood cells • white blood cells • platelets.
Research what to do if someone has a cut and is bleeding badly.	Recall that the blood moves around the body in: • arteries • veins • capillaries.
Examine an animal heart (or model).	Describe the functions of the heart in the pumping of blood, to include: • the right side of the heart pumping blood to the lungs • the left side of the heart pumping blood to the rest of the body. Recall that blood in arteries is under higher pressure than blood in the veins. Explain, in terms of pressure difference, why blood flows from one area to another.

Module B3: Living And Growing

Item B3e: The circulatory system

Links to other items: B1a: Fitness and health, B4d: Diffusion and osmosis, B5b: Circulatory system and the cardiac cycle, B5c: Running repairs

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how the structure of a red blood cell is adapted to its function: size, shape, contains haemoglobin, lack of nucleus. Describe the function of plasma.	Explain how the structure of a red blood cell is adapted to its function in terms of the small size providing a large surface area to volume ratio. Describe how haemoglobin in red blood cells reacts with oxygen in the lungs to form oxyhaemoglobin and how the reverse of this reaction happens in the tissues.
Describe how the parts of the circulatory system work together to bring about the transport of substances around the body, to include: • arteries transporting blood away from the heart • veins transporting blood to the heart • capillaries exchanging materials with tissues.	Explain how the adaptations of arteries, veins and capillaries relate to their functions, to include: • thick muscular and elastic wall in arteries • large lumen and presence of valves in veins • permeability of capillaries.
Identify the names and positions of the parts of the heart and describe their functions, to include: • left and right ventricles to pump blood • left and right atria to receive blood • semilunar, tricuspid and bicuspid valves to prevent backflow • four main blood vessels of the heart. Explain why the left ventricle has a thicker muscle wall than the right ventricle.	Explain the advantage of the double circulatory system in mammals, to include: • higher pressures • therefore greater rate of flow to the tissues.

Module B3: Living And Growing

Item B3f: Growth and development

Summary: The growth of organisms can be measured in different ways. Whilst there are similarities in the patterns of growth and development in all organisms there are some major variations between plants and animals. This item explores some of these differences. Research into human stem cells and cancer provides opportunities to discuss how and why decisions about science are made and the related ethical issues. These discussions can also provide the opportunity to show that there are some questions that science cannot currently answer.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Make an onion cell slide and examine it using a microscope.	Describe the functions of parts of a plant cell to include: • vacuole, containing cell sap and providing support • the cell wall, made of cellulose to provide support. Describe how to make a stained slide of an onion cell. Understand that bacterial cells are smaller and simpler than plant and animal cells.
Grow seedlings from seeds and measure their growth rate using different measurements. Plot data on weight gain of a baby using a case study or collected data. See Personal Child Health Record from Local Health Authority.	Recall that growth can be measured as an increase in height, wet mass or dry mass. Interpret data on a typical growth curve for an individual.
Research human stem cells. Research cancer (uncontrolled growth of cells).	Describe the process of growth as cell division followed by cells becoming specialised. Recall that the process of cells becoming specialised is called differentiation.
	Understand that animals grow in the early stages of their lives whereas plants grow continually. Understand that all parts of an animal are involved in growth whereas plants grow at specific parts of the plant.

Module B3: Living And Growing

Item B3f: Growth and development

Links to other items: B3d: Cell division, B5h: Growth and repair, B6a: Understanding microbes

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Identify simple differences between bacterial cells and plant and animal cells. Recall that bacterial cells lack: • a 'true' nucleus • mitochondria • chloroplasts.	Describe the difference between the arrangement of DNA in a bacterial cell and a plant/animal cell, to include: • presence/absence of a nucleus • single circular strand/chromosomes.
Recall that dry mass is the best measure of growth. Interpret data on increase in mass (including wet and dry mass). Describe the main phases of a typical growth curve. Recall that in human growth there are two phases of rapid growth, one just after birth and the other in adolescence.	Explain the advantages and disadvantages of measuring growth by: • length • wet mass • dry mass. Explain why the growth of parts of an organism may differ from the growth rate of the whole organism.
Recall that undifferentiated cells called stem cells can develop into different cells, tissues and organs. Recall that stem cells can be obtained from embryonic tissue and could potentially be used to treat medical conditions. Discuss issues arising from stem cell research in animals.	Explain the difference between adult and embryonic stem cells.
Explain why plant growth differs from animal growth, to include: • animals tend to grow to a finite size but many plants can grow continuously • plant cell division is mainly restricted to areas called meristems • cell enlargement is the main method by which plants gain height • many plant cells retain the ability to differentiate but most animal cells lose it at an early stage.	

Module B3: Living And Growing

Item B3g: New genes for old

Summary: Genetic engineering and genetic modification are relatively recent terms but humans have been genetically modifying animals and plants using selective breeding for thousands of years. Debating the arguments for and against GM and gene therapy provides opportunities to discuss how and why decisions about science are made. These discussions demonstrate the limitations of science to providing factual information and new techniques. The decisions as to whether to use these techniques need to be taken by representatives of the whole population.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Research examples of different animal and plant breeds that have been produced by selective breeding.	Describe the process of selective breeding as involving the: • selection of desired characteristics • cross breeding • selection of suitable offspring over many generations. Explain how selective breeding can contribute to improved agricultural yields.
Survey foods that contain GM ingredients. Research and present evidence for the benefits and risks of GM food. Research the differences between gene therapy and germ line treatment as possible treatments for genetic disorders.	Recall that: • selected genes can be artificially transferred from one living organism to another • this transfer of genes is called genetic engineering or genetic modification • the transfer of genes can produce organisms with different characteristics. Identify features of plants and animals that might be selected for in a genetic engineering programme.
	Recognise that in the future it may be possible to use genetic engineering to change a person's genes and cure certain disorders.

Module B3: Living And Growing

Item B3g: New genes for old

Links to other items: B3a: Molecules of life, B3h: Cloning, B6h: Gene technology

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recognise that a selective breeding programme may lead to inbreeding, which can cause health problems within the species.	Explain how a selective breeding programme may reduce the gene pool leading to problems of inbreeding, to include: • accumulation of harmful recessive characteristics • reduction in variation.
Explain some potential advantages and risks of genetic engineering: • advantage – organisms with desired features are produced rapidly • risks – inserted genes may have unexpected harmful effects. Describe, in outline only, some examples of genetic engineering: • taking the genes that control beta-carotene production and putting them into rice. Humans can then convert the beta-carotene from rice into Vitamin A (solving the problem of parts of the world relying on rice but lacking vitamin A) • the production of human insulin by genetically engineered bacteria • transferring resistance to herbicides, frost damage or disease to crop plants. Discuss the ethical issues involved in genetic modification.	Understand the principles of genetic engineering, to include: • selection of desired characteristics • isolation of genes responsible • insertion of the genes into other organisms • replication of these organisms.
Recall that changing a person's genes in an attempt to cure disorders is called gene therapy.	Recall that gene therapy could involve body cells or gametes. Explain why gene therapy involving gametes is controversial.

Module B3: Living And Growing

Item B3h: Cloning

Summary: Human individuals are unique, yet modern science has the ability to create genetically identical copies of complex organisms. This item considers the advantages and disadvantages of using this scientific knowledge. Finding out about the techniques used to produce Dolly, the first cloned animal provides the opportunity to illustrate the use of ICT in science, ethical issues about contemporary scientific developments and the role of the science community in validating changes in scientific knowledge.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Research information on the techniques used to produce Dolly, the first cloned mammal. Research the current scientific and legal position on xenotransplants.	Recall that: • cloning is an example of asexual reproduction • cloning produces genetically identical copies (clones). Recall that Dolly the sheep was the first mammal cloned from an adult. Recognise that identical twins are naturally occurring clones.
Carry out a meristem tissue culture using cauliflower.	Recognise that plants grown from cuttings or tissue culture are clones. Describe how spider plants, potatoes and strawberries reproduce asexually. Describe how to take a cutting.

Module B3: Living And Growing

Item B3h: Cloning

Links to other items: B1h: Variation and inheritance, B3d: Cell division, B3g: New genes for old

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand that Dolly the sheep was produced by the process of nuclear transfer and that nuclear transfer involves placing the nucleus of a body cell into an egg cell. Describe some possible uses of cloning, limited to: • mass producing animals with desirable characteristics • producing animals that have been genetically engineered to provide human products • producing human embryos to supply stem cells for therapy. Understand the ethical dilemmas concerning human cloning.	Describe in outline the cloning technique used to produce Dolly, to include: • nucleus removed from an egg cell • egg cell nucleus replaced with the nucleus from an udder cell • egg cell given an electric shock to make it divide • embryo implanted into a surrogate mother sheep • embryo grows into a clone of the sheep from which the udder cell came. Describe the benefits and risks of using cloning technology. Explain the possible implications of using genetically modified animals to supply replacement organs for humans.
Describe the advantages and disadvantages associated with the commercial use of cloned plants, to include: • advantage – can be sure of the characteristics of the plant since all plants will be genetically identical • advantage – it is possible to mass produce plants that may be difficult to grow from seed • disadvantage – if plants become susceptible to disease or to change in environmental conditions then all plants will be affected • disadvantage – lack of genetic variation.	Describe plant cloning by tissue culture, to include: • selection for characteristics • large number of small pieces of tissue • aseptic technique • use of suitable growth medium and conditions. Explain why cloning plants is easier than cloning animals: many plant cells retain ability to differentiate unlike animal cells which usually lose this ability at an early stage.

3.7 Module B4: It's A Green World

Module B4: It's A Green World

Item B4a: Ecology in the local environment

Summary: We are surrounded by a huge variety of living organisms, many of which go unnoticed. This item seeks to help candidates appreciate this variety. Candidates are introduced to methods of sampling and mapping animals and plants. It also provides an appreciation of the biodiversity of some artificial ecosystems.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Use a variety of sampling techniques to include pooters, nets, pitfall traps, quadrats, tullgren funnel, belt transects. Estimate the number of weeds in a field. Examine the variety of life in a one metre quadrat of turf or from a sample of leaf litter.	Describe how to use collecting/counting methods, to include: • pooters • nets • pitfall traps • quadrats. Describe a method to show the variety of plants and animals living in a small area such as a 1m quadrat. Use keys to identify plants and animals.
Compare the communities of two different habitats. Use sensors and data loggers to collect data such as temperature, light intensity and soil pH then link this with the animals and plants found in different places. Map the distribution of plant species at different distances from a pond/tree.	Explain how the distribution of organisms within a habitat is affected by the presence of other living organisms as well as physical factors.
Compare a cultivated area with an uncultivated area.	Define biodiversity as the variety of different species living in a habitat. Identify native woodlands and lakes as natural ecosystems and forestry plantations and fish farms as artificial ecosystems.

Module B4: It's A Green World

Item B4a: Ecology in the local environment

Links to other items: B2a: Classification, B2e: Adaptations, B2g: Population and pollution, B6e: Life in soil, B6f: Microscopic life in water

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Use data from collecting/counting methods to calculate an estimate of the population size based on: • scaling up from a small sample area • the use of capture-recapture data, given the formula: population size = $\frac{\text{number in 1st sample} \times \text{number in 2nd sample}}{\text{number in 2nd sample previously marked}}$	Explain the effect of sample size on the accuracy of an estimate of population size. Explain the need to make certain assumptions when using capture-recapture data, to include: • no death, immigration or emigration • identical sampling methods • marking not affecting survival rate.
Explain the differences between: • ecosystem and habitat • community and population. Describe how to map the distribution of organisms in a habitat using a transect line. Interpret data from kite diagrams showing the distribution of organisms.	Explain what it means for an ecosystem to be described as self supporting in all factors other than an energy source. Describe zonation as a gradual change in the distribution of species across a habitat. Explain how a gradual change of an abiotic factor can result in the zonation of organisms in a habitat.
Compare the biodiversity of natural ecosystems and artificial ecosystems to include: • native woodlands and lakes with forestry plantations and fish farms.	Explain reasons for the differences between the biodiversity of native woodlands and lakes compared with forestry plantations and fish farms.

Module B4: It's A Green World

Item B4b: Photosynthesis

Summary: Virtually everything we eat can be traced back to plants. Either we eat food from plants or we eat food from animals, that in turn have eaten plants. This item looks at how plants make food in the first place and what they do with it.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Test leaves for starch: variegated and non-variegated leaves and leaves deprived of light or carbon dioxide. Investigate the release of oxygen by pondweed.	Recall and use the word equation for photosynthesis: $\text{carbon dioxide + water} \xrightarrow[\text{(chlorophyll)}]{\text{(light energy)}} \text{glucose + oxygen}$ Understand that oxygen is a waste product in this reaction.
Draw a poster to show what happens to the glucose made in photosynthesis.	Recall that the glucose made in photosynthesis is transported as soluble sugars but is stored as insoluble starch. Recall that glucose and starch can be converted to other substances in plants to be used for energy, growth and storage products.
Investigate the effect of changing light intensity, temperature or carbon dioxide concentration on the rate of photosynthesis by measuring the rate of oxygen released from pondweed. Research how commercial glasshouses maximise the growth of crops by maximising the rate of photosynthesis.	Explain why plants grow faster in the summer because of more: • light • warmth.
	Understand that plants carry out respiration as well as photosynthesis.

Module B4: It's A Green World

Item B4b: Photosynthesis

Links to other items: B2b: Energy flow, B2c: Recycling, B3c: Respiration, B4c: Leaves and photosynthesis, B4d: Diffusion and osmosis, B4e: Transport in plants

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall and use the balanced symbol equation for photosynthesis: $6CO_2 + 6H_2O \xrightarrow[\text{(chlorophyll)}]{\text{(light energy)}} C_6H_{12}O_6 + 6O_2$ Describe the development of the understanding of the process of photosynthesis, to include: • the view of Greek scientists that plants gained mass only by taking in minerals from the soil • Van Helmont's experimental conclusion that plant growth cannot be solely due to nutrients from the soil • Priestley's experiment which showed that oxygen is produced by plants.	Explain how experiments using isotopes have increased our understanding of photosynthesis, to include: that oxygen produced by photosynthesis comes from the water and not the carbon dioxide. Describe photosynthesis as a two stage process: • light energy is used to split water, releasing oxygen gas and hydrogen ions • carbon dioxide gas combines with the hydrogen to make glucose.
Describe the conversion of glucose and starch to other substances in plants and their use: • glucose for energy (respiration) • cellulose for cell walls • proteins for growth and repair • starch, fats and oils for storage.	Explain why insoluble substances such as starch are used for storage: • does not move away in solution from storage areas • does not affect water concentration inside cells.
Describe how photosynthesis can be increased by providing: • more carbon dioxide • more light • higher temperature.	Explain the effects of limiting factors on the rate of photosynthesis: • CO_2 • light • temperature.
Explain why plants carry out respiration all the time.	Explain why plants take in carbon dioxide and give out oxygen during the day and do the reverse at night, in terms of both photosynthesis and respiration.

Module B4: It's A Green World

Item B4c: Leaves and photosynthesis

Summary: To most teenagers, plants are there to be eaten and sometimes admired for their colourful flowers. This item seeks to consolidate understanding of how green plants work. Preparing and examining slides of leaves provides the opportunity to work accurately and safely and present information using scientific and mathematical conventions.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine a variety of leaves to look at common features. Design the 'ideal' leaf. Make leaf prints and examine stomata under a microscope. Examine prepared microscope slides showing the internal structure of leaves. Use ICT to examine leaves www.plantscienceimages.org.uk.	Understand why chloroplasts are not found in all plant cells. Recall that chlorophyll pigments in chloroplasts absorb light energy for photosynthesis. Recall the entry points of materials required for photosynthesis: • water through root hairs • carbon dioxide through stomata. Recall the exit point of materials produced in photosynthesis: • oxygen through stomata. Understand that broader leaves enable more sunlight to be absorbed.

Module B4: It's A Green World

Item B4c: Leaves and photosynthesis

Links to other items: B1g: Controlling plant growth, B4b: Photosynthesis, B4d: Diffusion and osmosis

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Name and locate the parts of a leaf: • cuticle • upper and lower epidermis • palisade and spongy mesophyll layers • stomata and guard cells • vascular bundle. Explain how leaves are adapted for efficient photosynthesis: • broad so large surface area • thin so short distance for gases to diffuse • contain chlorophyll and other pigments to absorb light from different parts of the spectrum • have a network of vascular bundles for support and transport • guard cells which open and close the stomata.	Explain how the cellular structure of a leaf is adapted for efficient photosynthesis: • epidermis is transparent • palisade layer at the top containing most of the chloroplasts • air spaces in the spongy mesophyll allow diffusion between stomata and photosynthesising cells • internal surface area to volume ratio very large. Interpret data on the absorption of light by photosynthetic pigments (chlorophyll a and b, carotene and xanthophyll) to explain how plants maximise the use of energy from the Sun.

Module B4: It's A Green World

Item B4d: Diffusion and osmosis

Summary: The materials used in, and produced by, life processes, move through living organisms in several ways, one of the most important of these being diffusion. One such material is water which is needed for key life processes such as photosynthesis, support and transport of materials. Water enters plants by a type of diffusion called osmosis.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Demonstrate diffusion e.g. spread of perfume across a room, potassium permanganate in water. Investigate the rate of diffusion of food dye through agar jelly.	Recall that substances move in and out of cells by diffusion through the cell membrane. Describe diffusion as the movement of a substance from a region of high to low concentration.
Carry out experiments to demonstrate osmosis using visking tubing and solutions of various concentrations.	Recognise that water moves in and out of plant cells by osmosis through the cell membrane.
Investigate the effects of changing solute concentration on potato discs/strips.	Recall that the plant cell wall provides support. Understand that lack of water can cause plants to droop (wilt).
Make leaf prints of upper and lower surfaces of leaves and examine with a microscope to investigate number/distribution of stomata.	Describe how carbon dioxide and oxygen diffuse in and out of plants through the leaves.
	Recall that water moves in and out of animal cells through the cell membrane.

Module B4: It's A Green World

Item B4d: Diffusion and osmosis

Links to other items: B3d: Cell division, B3e: The circulatory system, B4c: Leaves and photosynthesis, B5d: Respiratory systems, B5e: Digestion, B5f: Waste disposal

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the net movement of particles by diffusion from an area of high concentration to an area of low concentration, as a consequence of the random movement of individual particles. Describe how molecules enter and leave cells by diffusion through the cell membrane.	Explain how the rate of diffusion is increased by: • a shorter distance • a greater concentration difference (gradient) • a greater surface area.
Describe osmosis as the movement of water across a partially-permeable membrane from an area of high water concentration (i.e. dilute solution) to an area of low water concentration (i.e. concentrated solution). Recall that osmosis is a type of diffusion. Explain the term partially-permeable.	Explain the net movement of water molecules by osmosis from an area of high water concentration to an area of low water concentration across a partially-permeable membrane, as a consequence of the random movement of individual particles. Predict the direction of water movement in osmosis.
Explain how plants are supported by the turgor pressure within cells: • water pressure acting against inelastic cell wall. Explain wilting in terms of a lack of turgor pressure.	Explain the terms: flaccid, plasmolysed and turgid.
Explain how leaves are adapted to increase the rate of diffusion of carbon dioxide and oxygen.	
Describe the effects of the uptake and loss of water on animal cells.	Explain why there are differences in the effects of water uptake and loss on plant and animal cells. Use the terms: crenation and lysis.

Module B4: It's A Green World

Item B4e: Transport in plants

Summary: The materials used in, and produced by, life processes in plants, move through plants in several ways. The suggested activities each provide the opportunity to plan a test of a scientific idea, analyse and interpret data using qualitative techniques, present information and draw a conclusion using scientific and technical conventions. Investigating factors affecting transpiration rate can include the use of ICT in teaching and learning and illustrates the use of models in explaining scientific phenomena.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine stained tissues of some species of plants.	
Carry out experiments to estimate transpiration • loss of water by plants • plants lose water through their leaves • which surface of a leaf loses most water • weighing potted plants – loss of mass.	Describe how water travels through a plant: • absorption from soil through root hairs • transport through the plant, up the stem to the leaves • evaporation from the leaves (transpiration).
Carry out an experiment to show factors that affect transpiration rate: • light • wind • temperature • humidity. ICT data logging opportunity.	Describe experiments to show that transpiration rate is affected by: • light intensity • temperature • air movement • humidity.
Investigate how quickly detached leaves dry out when different surfaces are covered with petroleum jelly.	Understand that healthy plants must balance water loss with water uptake.

Module B4: It's A Green World

Item B4e: Transport in plants

Links to other items: B4b: Photosynthesis, B4d: Diffusion and osmosis

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the arrangement of xylem and phloem in a dicotyledonous root, stem and leaf, to include vascular bundles. Relate xylem and phloem to their function: • xylem – transpiration – movement of water and minerals from the roots to the shoot and leaves • phloem – translocation – movement of food substances (sugars) up and down stems to growing and storage tissues. Understand that both xylem and phloem form continuous systems in leaves, stems and roots.	Describe the structure of xylem and phloem: • xylem vessels – thick strengthened cellulose cell wall with a hollow lumen (dead cells) • phloem – columns of living cells.
Recall transpiration as the evaporation and diffusion of water from inside leaves. Describe how transpiration causes water to be moved up xylem vessels.	Explain how transpiration and water loss from leaves are a consequence of the way in which leaves are adapted for efficient photosynthesis.
Describe the effect on transpiration rate of: • increase in light intensity • increase in temperature • increase in air movement • decrease in humidity. Interpret data from experiments on transpiration rate.	Explain why transpiration rate is increased by: • increase in light intensity • increase in temperature • increase in air movement • decrease in humidity.
Explain how root hairs increase the ability of roots to take up water by osmosis. Recall that transpiration provides plants with water for: • cooling • photosynthesis • support • movement of minerals. Explain how the structure of a leaf is adapted to reduce excessive water loss: • waxy cuticle • small number of stomata on upper surface.	Explain how the cellular structure of a leaf is adapted to reduce water loss: • changes in guard cell turgidity (due to light intensity and availability of water) to regulate stomatal apertures • number, distribution, position and size of stomata.

Module B4: It's A Green World

Item B4f: Plants need minerals

Summary: Candidates should appreciate that a balanced diet contains minerals and vitamins. The actual amounts needed are small but without them our health will suffer. Plants also need minerals and without them their growth will suffer. The survey of the contents of 'plant foods' provides the opportunity to use ICT sources and tools to collect secondary data.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey the contents of fertilisers such as 'plant foods'. Practicals available from SAPS (How Science Works practical activities).	Recall that fertilisers contain minerals such as nitrates, phosphates, potassium and magnesium compounds and that these are needed for plant growth. Interpret data on NPK values to show the relative proportions of nitrates, phosphates and potassium in fertilisers.
Carry out an experiment to show the results of mineral deficiencies in plants. Investigate the contents and manufacture of organic and synthetic fertilisers.	Describe experiments to show the effects on plants of mineral deficiencies: • soil-less culture • each trial missing one mineral.
	Describe how minerals are absorbed, to include: • dissolved in solution • by the root hairs • from the soil.

Module B4: It's A Green World

Item B4f: Plants need minerals

Links to other items: B2c: Recycling, B4g: Decay, B4h: Farming

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain why plants require: • nitrates: for proteins which are needed for cell growth • phosphates: for respiration and growth • potassium compounds: for respiration and photosynthesis • magnesium compounds: for photosynthesis.	Describe how elements obtained from soil minerals are used in the production of compounds in plants, limited to: • nitrogen to make amino acids • phosphorus to make DNA and cell membranes • potassium to help enzymes (in photosynthesis and respiration) • magnesium to make chlorophyll.
Relate mineral deficiencies to the resulting poor plant growth: • nitrate – poor growth and yellow leaves • phosphate – poor root growth and discoloured leaves • potassium – poor flower and fruit growth and discoloured leaves • magnesium – yellow leaves.	
Recall that minerals are usually present in soil in quite low concentrations.	Explain how minerals are taken up into root hair cells by active transport. Understand that active transport can move substances from low concentrations to high concentrations (against the concentration gradient), across a cell membrane, using energy from respiration.

Module B4: It's A Green World

Item B4g: Decay

Summary: We try to prevent food going off (decaying) but we want decay to happen when sewage is treated or when compost is made. This item is concerned with the process of decay and some examples. The experiments on decay provide the opportunity to plan a test of a scientific idea, analyse and interpret data using qualitative and quantitative techniques, present information and draw a conclusion using scientific and technical conventions. The survey of preservation techniques provides the opportunity to use ICT sources and tools to collect secondary data.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine results (e.g. photographs) of long term decay of compost.	Recall the key factors in the process of decay: • presence of microorganisms • temperature • oxygen • moisture. Explain why decay is important for plant growth.
Carry out an experiment to show decay e.g. bread or fruit. Investigate the effect of temperature on decay.	Describe how to carry out an experiment to show that decay is caused by the decomposers bacteria and fungi.
Make a compost column. Visit a sewage works.	Recall that microorganisms are used to: • break down human waste (sewage) • break down plant waste (compost).
Survey different food preservation methods and explain how each works. Investigate different food preservation methods.	Recognise that food preservation techniques reduce the rate of decay: • canning • cooling • freezing • drying • adding salt/sugar • adding vinegar.

Module B4: It's A Green World

Item B4g: Decay

Links to other items: B3c: Respiration, B4f: Plants need minerals, B4h: Farming, B6d: Biofuels, B6e: Life in soil

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the effects on the rate of decay of changing: • temperature • amount of oxygen • amount of water.	Explain why changing temperature, and the amounts of oxygen and water, affect the rate of decay in terms of the: • effect on microbial respiration • effect on growth and reproduction of microorganisms.
Recall that detritivores, including earthworms, maggots and woodlice, feed on dead and decaying material (detritus). Explain how detritivores increase the rate of decay by producing a larger surface area.	Explain the term saprophyte. Explain how saprophytic fungi digest dead material, in terms of extracellular digestion.
Explain how food preservation methods reduce the rate of decay.	

Module B4: It's A Green World

Item B4h: Farming

Summary: Organic farming has become more widespread but intensive farming techniques are more common. This item looks at the issues concerning sustainable food production. Discussing different farming methods provides many opportunities to investigate why decisions about science and technology are made and the ethical issues raised. This can be developed to look at the social, economic and environmental effects of such decisions.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Arrange a visit to a local farm/garden centre/small holding.	Analyse data to show that farmers can produce more food if they use pesticides and understand that these practices can cause harm to the environment and to health. Recall that pesticides kill pests which are any organisms that damage crops. Recall that examples of pesticides include: • insecticides to kill insects • fungicides to kill fungi • herbicides to kill plants (weeds).
Role-play exercise to highlight different view points on intensive farming.	Recall that intensive farming means trying to produce as much food as possible from the land, plants and animals available. Describe how intensive farming methods can increase productivity methods limited to: • fish farming • glasshouses • hydroponics • battery farming.
Survey use of organic food and reasons for choice. Grow lettuce/tomato plants using hydroponics. Investigate websites such as DEFRA, LEAF.	Describe organic farming methods: • no artificial fertilisers • no pesticides.
	Describe how pests can be controlled biologically by introducing predators.

Module B4: It's A Green World

Item B4h: Farming

Links to other items: B1g: Controlling plant growth, B4a: Ecology in the local environment, B4f: Plants need minerals, B4g: Decay, B6d: Biofuels

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the disadvantages of using pesticides: • pesticides may enter and accumulate in food chains • pesticides may harm organisms which are not pests • some pesticides are persistent.	
Describe how plants can be grown without soil (hydroponics). Describe possible uses of hydroponics, to include: • glasshouse tomatoes • plant growth in areas of barren soil. Understand that intensive farming methods may be efficient but they raise ethical dilemmas.	Explain the advantages and disadvantages of hydroponics: • better control of mineral levels and disease • lack of support for plant • required addition of fertilisers. Explain how intensive food production improves the efficiency of energy transfer by reducing energy transfer: • to pests, including competing plants (weeds) • as heat from farm animals by keeping them penned indoors (battery farming) so that they are warm and move around less.
Describe organic farming techniques: • use of animal manure and compost • crop rotation including use of nitrogen-fixing crops • weeding • varying seed planting times. Explain the advantages and disadvantages of organic farming techniques.	
Explain the advantages and disadvantages of biological control, to include: • advantages: no need for chemical pesticides, does not need repeated treatment • disadvantages: predator may not eat pest, may eat useful species, may increase out of control, may not stay in the area where it is needed. In the context of biological control, explain how removing one or more organisms from a food chain or web may affect other organisms.	

3.8 Module B5: The Living Body

Module B5: The Living Body

Item B5a: Skeletons

Summary: Movement is part of our daily lives. Efficient movement relies on a functioning skeletal and muscular system. Accidents do happen and bones can be broken. This item aims to provide the necessary science to understand the structure of bones and joints, and how damage can be detected, using contemporary technological developments.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine X-rays of skeletons: • child and adult • arthritic joint • with rickets • with fractures. Examine human and animal skeletons and identify some of the bones.	Recall that: • some animals, including worms, do not have a skeleton made of hard material • some animals, including insects, have an external skeleton • some animals, including humans, have an internal skeleton. Recall that an insect's external skeleton is made of chitin. Describe the different forms of internal skeleton: • made only of cartilage (limited to sharks) • made mainly of bone with some cartilage (outer ear, nose, end of long bones) (to include humans).
Research technologies which assess the health of bones e.g. bone density scans.	Describe the different types of fractures of bones: • simple • compound • green stick. Recall that X-rays are used to detect fractures.
Carry out an experiment to compare the strengths of solid and hollow structures.	Describe a joint as the place where two or more bones meet (joined by ligaments) and recognise that the bones are moved by muscles (attached by tendons). Identify the locations in the human body of a fixed joint (skull), hinge joint (elbow, knee), and ball and socket joint (shoulder, hip).
	Identify the main bones (humerus, ulna, radius) and muscles (biceps, triceps) in a human arm.

Module B5: The Living Body

Item B5a: Skeletons

Links to other items: B1a: Fitness and health

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain why an internal skeleton is advantageous compared with an external skeleton: • framework of body • can grow with body • easy to attach muscles • flexibility. Understand that cartilage and bone are living tissues. Describe the structure of a long bone: • head with covering of cartilage • shaft containing bone marrow with blood vessels. Explain why long bones that are hollow are advantageous, in terms of weight and strength.	Understand that cartilage and bone are susceptible to infection but can grow and repair themselves. Describe how, in humans, the skeleton starts off as cartilage but is ossified: cartilage is slowly replaced by the addition of calcium and phosphorus (ossification); and that whether a person is still growing can be determined by the amount of cartilage present.
Recall that, despite being very strong, bones can easily be broken by a sharp knock. Explain why elderly people are more prone to fractures, limited to osteoporosis.	Explain why it can be dangerous to move a person with a suspected fracture.
Describe the structure of synovial joints: synovial fluid, synovial membrane, ligaments, cartilage. Describe the types and range of movement in: • a ball and socket • hinge joint.	Explain the functions in a synovial joint of: • synovial fluid • synovial membrane • cartilage • ligaments.
Describe how the biceps and triceps muscles operate (by contraction and relaxation) as antagonistic muscles to bend or straighten the arm.	Explain how the arm bending and straightening is an example of a lever.

Module B5: The Living Body

Item B5b: Circulatory systems and the cardiac cycle

Summary: Our heart beats automatically from before birth until we die; it also adjusts itself to varying levels of activity. The history of discoveries about blood circulation is an interesting story culminating in our increasing use of modern technology. Using video clips to show heart action is an example of using ICT in teaching and learning while ECG traces illustrate the use of ICT in science.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Listen/watch Tony Hancock's classic 'The Blood Donor'. Construct a time-line of discoveries about blood circulation using various sources. Research heart disease in the world and display the information using charts and graphs.	Recall that: • some animals, including amoeba, do not have a blood circulatory system • some animals, including insects, have an open circulatory system • some animals, including humans, have a closed circulatory system. Understand the difference between open and closed circulatory systems. Recall that in a closed circulatory system, blood will flow in arteries, veins and capillaries.
Watch video/flash clips on heart action.	Understand how heart muscle causes blood to move.
Interpret an electrocardiograph (ECG) trace of a normal beat (PQRS wave).	Describe the heart as made of powerful muscles which are supplied with food substances, including glucose, and oxygen by the coronary artery. Understand why the heart needs a constant supply of glucose and oxygen. Describe the pulse as a measure of the heart beat (muscle contraction) to put the blood under pressure and recognise that it can be detected at various places (wrist, ear, temple).

Module B5: The Living Body

Item B5b: Circulatory systems and the cardiac cycle

Links to other items: B3e: The circulatory system, B5c: Running repairs

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain why many animals need a blood circulatory system. Describe a single circulatory system as being one circuit from the heart. Describe a double circulatory system as being two circuits from the heart. Compare the circulatory systems of fish and mammals.	Describe the contribution of Galen (2nd century) (importance of the pulse, the difference between blood in arteries and veins) and William Harvey (17th century) (circulation) towards the understanding of blood circulation. Explain why a single circulatory system links to a two-chambered heart. Explain why a double circulatory system links to a four-chambered heart. Understand that the blood is under a higher pressure in a double circulatory system compared with a single circulatory system and how this allows materials to be transported more quickly around the body.
Interpret data on pressure changes in arteries, veins and capillaries.	Describe the cardiac cycle and interpret associated graphs and charts. Explain the sequence of contraction of the atria and ventricles and the sequence of opening of the semilunar and atrio-ventricular valves.
Describe how heart rate is linked to activity. Understand how heart muscle contraction is controlled: by groups of cells called the pacemakers which produce a small electric current that stimulates muscle contraction. Recognise that artificial pacemakers are now commonly used to control heart beat. Recognise that techniques such as ECG and echocardiograms are used to investigate heart action. Recall that heart rate can be increased by the hormone adrenaline.	Describe how the pacemaker cells (SAN and AVN) coordinate heart muscle contraction: • impulses from the SAN cause the atria to contract and stimulate the AVN • impulses from the AVN cause the ventricles to contract. Interpret data from ECG and echocardiograms.

Module B5: The Living Body

Item B5c: Running repairs

Summary: Our heart and circulation can go wrong. We need to understand how our lifestyle can cause this. We also need to know how these faults can be detected and how they can be put right using modern surgical techniques. This item allows discussion on some of the decisions and ethical issues around blood donation.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine models of the heart and heart valves. Watch videos/flash clips to show action of valves. Research types of heart valves. Research causes of heart disease.	Recognise that there are many heart conditions and diseases, to include: • irregular heart beat • hole in the heart • damaged or weak valves • coronary heart disease and heart attacks.
Research the incidence of haemophilia in Europe's royal families. Visit or listen to a presentation from the National Blood Service.	Describe reasons for blood donation. Recall that there are different blood groups called A, B, AB and O, which are further subdivided into Rhesus positive and negative. Describe the function of blood clots at cuts and appreciate that they sometimes occur abnormally inside blood vessels. Recall that anti-coagulant drugs can be used to reduce clotting.

Module B5: The Living Body

Item B5c: Running repairs

Links to other items: B1a: Fitness and health, B3e: The circulatory system, B5b: Circulatory systems and the cardiac cycle, B5h: Growth and repair

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the consequences of a 'hole in the heart': • blood can move directly from one side of the heart to the other side of the heart • less oxygen in the blood • can require correction by surgery. Explain the consequences of damaged or weak valves in the heart: • reduce effective blood circulation • can require replacement by artificial valves. Explain the consequences of a blocked coronary artery: • reduces blood flow to the heart muscle • can require treatment by bypass surgery. Recognise that there are 'heart assist' devices as well as heart transplants.	Explain how a 'hole in the heart' results in less oxygen in the blood. Understand why unborn babies can all have a 'hole in the heart' and do not need a double circulatory system and why the hole closes soon after birth. Explain the advantages and disadvantages of a heart pacemaker or artificial heart valves over a heart transplant.
Describe the processes of: • blood donation • blood transfusion. Recall that haemophilia is an inherited condition in which the blood does not easily clot. Recall that drugs such as warfarin, heparin and aspirin are used to control clotting. Describe the process of blood clotting, limited to: • platelets in contact with damaged blood vessels, causing a series of chemical reactions leading to the formation of a mesh of fibrin fibres (clot).	Recall that unsuccessful blood transfusions cause agglutination (blood clumping). Explain how the presence of antigens and antibodies in red blood cells and blood serum determines how blood groups react and therefore whether a blood transfusion is successful. Describe which blood groups (A, B, AB and O) have: • antigens A and B • antibodies anti-A and anti-B. Explain which blood groups can be used to donate blood to which other blood groups.

Module B5: The Living Body

Item B5d: Respiratory systems

Summary: With today's polluted atmosphere, many people suffer from respiratory diseases. This unit looks at how respiratory systems work and at respiratory problems, their causes and possible treatments. The experimental work on measuring lung capacities, respiration and peak flow develop the ability to present and analyse information using technical and mathematical language.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment to show the different amounts of carbon dioxide in inhaled and exhaled air.	Understand why most living things need oxygen to release energy from food. Understand that small simple organisms, including amoeba and earthworms, take in oxygen through their moist and permeable external surfaces. Recognise that larger, more complex animals have special organs for exchange of gases, such as gills and lungs. Understand how surface area affects the exchange of gases.
Examine a model of a bell jar and rubber sheet to explain breathing. Measure lung capacities.	Describe the functions of the main parts of the human respiratory system (trachea, bronchus, bronchioles, lungs, alveoli, pleural membranes, ribs, intercostal muscles and diaphragm). Explain the terms breathing, respiration, inspiration (inhalation) and expiration (exhalation). Describe the direction of exchange of carbon dioxide and oxygen at the lungs and in tissues.
Carry out an experiment to test peak flow of individuals. Research one or more industrial respiratory diseases and present the information in a poster or leaflet.	Recall that there are many conditions and diseases of the respiratory system, to include: • asthma, bronchitis, pneumonia and lung cancer.

Module B5: The Living Body

Item B5d: Respiratory systems

Links to other items: B1b: Human health and diet, B1e: Drugs and you, B3c: Respiration, B4d: Diffusion and osmosis

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recognise that the methods of gaseous exchange of amphibians and fish restrict them to their habitats: • amphibians need moist habitats • fish gills only work in water.	Explain why the methods of gaseous exchange of amphibians and fish restrict them to their habitats: • the permeable skin of amphibians makes them susceptible to excessive water loss • fish gills work by forcing water across the filaments.
Understand the process of ventilation in terms of changing volume and pressure to include breathing in humans. Explain the terms tidal air, vital capacity air and residual air as part of the total lung capacity. Explain how gaseous exchange occurs within alveoli by diffusion between air and blood.	Explain how gaseous exchange surfaces are adapted for efficient gaseous exchange (permeable, moist surface, large surface area, good blood supply and thin lining (one cell thick)). Interpret data on lung capacities (from a spirometer).
Describe how the respiratory system protects itself from disease by mucus and ciliated cells in the trachea and bronchi. Recognise that there are lung diseases: • with industrial causes (such as asbestosis) • with genetic causes (such as cystic fibrosis) • caused by life style (such as lung cancer). and briefly describe each disease: • asbestosis – inflammation and scarring limiting gas exchange • cystic fibrosis – too much mucus in the bronchioles • lung cancer – cells grow rapidly reducing surface area in lungs. Describe the symptoms of asthma (difficulty breathing, wheezing, tight chest) and its treatment (inhalers).	Explain why the respiratory system is prone to diseases. Describe what happens during an asthma attack: • lining of airways becomes inflamed • fluid builds up in airways • muscles around bronchioles contract constricting airways.

Module B5: The Living Body

Item B5e: Digestion

Summary: Food provides the raw materials for growth as well as being the source of the energy we release through respiration. The different parts of the digestive system are each adapted for their own roles in digesting and absorbing food.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Investigate the digestion of starch, protein and fat using simple food tests.	Describe the position and function of the parts of the human digestive system: • salivary glands • stomach • pancreas • liver and gall bladder • small intestine • large intestine. Describe the process of physical digestion as breaking food into smaller pieces by: • chewing in the mouth • squeezing in the stomach. Understand that in chemical digestion the digestive enzymes breakdown large food molecules into smaller ones so they can be absorbed into the blood.
Investigate the movement of food molecules across partially permeable membranes.	Recognise that food enters the blood in the small intestine and leaves in body tissues.

Module B5: The Living Body

Item B5e: Digestion

Links to other items: B1b: Human health and diet, B3b: Proteins and mutations, B4d: Diffusion and osmosis

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the importance of physical digestion: • to pass more easily through the digestive system • to provide a larger surface area. Explain how carbohydrates, proteins and fats are digested by specific enzymes in the mouth, stomach and small intestine respectively, limited to: • carbohydrase breaks down starch to sugar • protease breaks down protein to amino acids • lipase breaks down fat to fatty acids and glycerol. Recall that stomach acid aids protease function.	Explain how bile, from the gall bladder, improves fat digestion. Explain why the pH in the stomach is maintained at acidic levels, whereas the pH in the mouth and small intestine is alkaline or neutral. Understand that the breakdown of starch is a two step process involving the breakdown of starch into maltose and maltose into glucose.
Understand why large molecules need to be broken down into small molecules. Describe how small digested food molecules are absorbed into the blood plasma or lymph in the small intestine by diffusion.	Explain how the small intestine is adapted for the efficient absorption of food.

Module B5: The Living Body

Item B5f: Waste disposal

Summary: Our bodies produce waste, which is often toxic. To avoid poisoning ourselves, we must get rid of this waste. What role do our kidneys, skin and lungs play in this process? Researching methods of respiratory and kidney failure can be used to illustrate contemporary scientific and technological developments.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out experiments to test mock urine samples. Research kidney failure and its treatment.	Explain the difference between egestion and excretion. Name and locate the positions of the main organs of excretion: • lungs • kidneys • skin. Recall that the kidneys excrete urea, water and salt in urine. Understand that the amount and concentration of urine produced is affected by water intake, temperature and exercise.
Investigate the effect of exercise on rate of breathing.	Recall that carbon dioxide produced by respiration, is removed from the body through the lungs.

Module B5: The Living Body

Item B5f: Waste disposal

Links to other items: B1e: Drugs and you, B1f: Staying in balance, B4d: Diffusion and osmosis

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand the importance of maintaining a constant concentration of water molecules in blood plasma. Describe the gross structure of a kidney and associated blood vessels (cortex, medulla, ureter, renal artery, renal vein). Explain how kidneys work: • filter blood at high pressure • re-absorb water and useful substances. Recall that urea, produced in the liver (from excess amino acids), is removed from the blood by the kidneys. Explain why the amount and concentration of urine produced is affected by water intake, heat and exercise.	Explain how the structure of the kidney tubule (nephron) is related to filtration of the blood and formation of urine: • a filter unit of glomerulus and capsule • a region for selective reabsorption • a region for salt and water regulation. Explain the principle of a dialysis machine and how it removes urea and maintains levels of sodium and glucose in the blood of a patient with kidney failure. Explain how the concentration of urine is controlled by the antidiuretic hormone (ADH), released by the pituitary gland: • ADH increases permeability of kidney tubules so more water is reabsorbed back into the blood • ADH production is controlled by a negative feedback mechanism.
Explain why carbon dioxide must be removed from the body, limited to the toxic effect of high levels.	Explain how the body responds to increased carbon dioxide levels in the blood: • detected by the brain • increased rate of breathing results.

Module B5: The Living Body

Item B5g: Life goes on

Summary: Humans, like all other animals, have basic needs for survival and reproduction to carry on our species. When things do not work as they should we expect modern techniques to solve our problem. Sometimes solutions raise other issues.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine microscope slides of testes and ovaries. Examine models of a developing foetus.	Describe the function of the scrotum: • keeps the testes outside the body where the temperature is better for sperm development. Describe the main stages of the menstrual cycle: • menstruation – uterus lining breaks down (period) • thickening of uterus lining • ovulation – egg released by ovary.
Role play or debate about using infertility treatments.	Understand that fertilisation and pregnancy are not guaranteed for all couples. Understand the causes of infertility, limited to: • blockage of fallopian tubes or sperm ducts • eggs not developed or released from ovaries • insufficient fertile sperm produced by testes. Recognise that in some, but not all, cases pregnancy can be achieved with the help of fertility treatment.
	Understand reasons for checking foetal development.
	Name and locate human endocrine glands and name the hormones produced: • ovaries – oestrogen, progesterone • testes – testosterone.

Module B5: The Living Body

Item B5g: Life goes on

Links to other items: B1h: Variation and inheritance, B5h: Growth and repair

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the role of hormones in the menstrual cycle: • oestrogen causes the repair of the uterus wall • progesterone maintains the uterus wall • FSH (follicle-stimulating hormone) stimulates an egg to develop • LH (luteinising hormone) controls ovulation. Recall that FSH and LH are released by the pituitary gland in the brain.	Explain how negative feedback mechanisms affect hormone production in the menstrual cycle.
Explain treatments for infertility to include: • artificial insemination • use of FSH • "in vitro" fertilisation (IVF) • egg donation • surrogacy • ovary transplants. Explain the arguments for and against such infertility treatments.	Evaluate infertility treatments in terms of moral issues, risks and benefits.
Describe how foetal development can be checked to identify conditions such as Down's syndrome using amniocentesis and chromosomal analysis. Explain why foetal screening raises ethical issues.	
Recall that fertility in humans can be controlled by the artificial use of sex hormones: contraceptive pill and fertility drugs.	Explain how fertility can be reduced by the use of female hormones (contraception) which prevent ovulation by mimicking pregnancy – inhibiting FSH release.

Module B5: The Living Body

Item B5h: Growth and repair

Summary: We start life as a microscopic fertilised egg and grow at different rates at different times of our lives and are sometimes surprised to find we have reached a height of nearly two metres. However, as people live longer, parts of their bodies wear out or go wrong. This item encourages discussion about possible treatments and ethical issues involved. It also provides the opportunity to debate the issues.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Measure heights of candidates in your class/year and display as normal distributions for boys and girls. Collect data from another year group and compare distributions. Use websites/visit museums/use reference books to find out average heights during history (look at suits of armour, door heights in old buildings, height requirements for the Armed Forces).	Recall that growth can be measured as an increase in height or mass. Understand that a person's final height and mass is determined by a number of factors, including: • their genes • diet and exercise • hormones • health/disease. Describe the main stages of human growth and identify them on a human growth curve: • infancy (up to 2 years) • childhood (from 2 to 11 years) • adolescence (puberty) (from 11 to 13/15 years) • maturity (adulthood) (the longest stage) • old age (above 60/65 years).
Research donor cards and other donor organisations such as the Anthony Nolan Trust.	Recall that, due to disease or trauma, it is sometimes necessary to replace body parts with biological or mechanical parts. Recall that some mechanical replacements such as the heart and lung machine, kidney dialysis and mechanical ventilators are used outside the body.
Research the history of one organ transplant.	Understand that organs can be donated by living or dead donors.

Module B5: The Living Body

Item B5h: Growth and repair

Links to other items: B3f: Growth and development, B5c: Running repairs

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall that extremes of height are usually caused by genes or hormone imbalance. Describe how diet and exercise can influence growth. Recognise that different parts of a foetus and a baby grow at different rates. Understand why a baby's length, mass and head size are regularly monitored during their first months: to provide early warning of growth problems. Understand the use of average growth charts. Explain possible causes of the increase in life expectancy during recent times, to include: less industrial disease, healthier diet and life style, modern treatments and cures for disease and better housing.	Recall that the human growth hormone is produced by the pituitary gland and that it stimulates general growth especially in long bones. Describe possible consequences of more people living longer, on a personal and national level.
Explain problems in supply of donor organs, limited to: • shortage of donors • tissue match • size and age. Explain problems of using mechanical replacements, limited to: • size • power supply • materials used • body reactions. Describe the ethical issues concerning organ donation.	Describe problems with transplants, limited to: • rejection • immuno-suppressive drug treatment.
Explain why donors can be living and what makes a suitable living donor. Describe the criteria needed for a dead person to be a suitable donor.	Describe the advantages and disadvantages of a register of donors. Interpret data on transplants and success rates.

3.9 Module B6: Beyond The Microscope

Module B6: Beyond The Microscope

Item B6a: Understanding microbes

Summary: We are used to talking about plants and animals that can be seen and touched. Microscopic organisms such as bacteria, viruses and fungi tend to be either ignored or cause fear. This unit considers the characteristics of these organisms and gives some appreciation of the importance of scale in biology. Practical work with microorganisms develops the skills of working safely and accurately.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine greatly magnified images of bacteria and calculate magnification. 'How big would a cat be if we magnified it by the same factor?' is a useful problem to solve. Prepare a culture of bacteria on an agar plate using aseptic technique.	Recall that the size of a typical bacterial cell is just a few microns (thousandths of a mm). Identify and label parts of a flagellate bacillus as shown by *E. coli*, to include: • flagellum • cell wall • bacterial DNA. Recognise that bacteria can be classified by their shape. Describe how bacteria reproduce by splitting into two. Understand that bacteria can reproduce very rapidly in suitable conditions. Recognise that bacteria can be grown in large fermenters.
Make a slide of yeast and stain it with methylene blue and examine it under a microscope.	Recall that yeast is a fungus. Identify and label parts of a yeast cell, to include: • nucleus • cytoplasm • cell wall • bud. Describe how yeast reproduces asexually by budding.
	Understand that viruses are: • not living cells • much smaller than bacteria and fungi.

Module B6: Beyond The Microscope

Item B6a: Understanding microbes

Links to other items: B1c: Staying healthy, B2a: Classification, B3d: Cell division, B4g: Decay, B6b: Harmful microorganisms

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe how the parts of bacterial cells relate to their function, to include: • flagellum for movement • cell wall to maintain shape, and to stop it from bursting • DNA to control the cell's activities and replication of the cell. Describe the main shapes of bacteria as: • spherical • rod • spiral • curved rods. Recall that bacteria reproduce by a type of asexual reproduction called binary fission. Describe aseptic techniques for culturing bacteria on an agar plate.	Explain how bacteria: • can survive on an enormous range of energy sources • can exploit a very wide range of habitats because some bacteria can consume organic nutrients and others can make their own. Explain the consequences of very rapid bacterial reproduction in terms of food spoilage and disease. Explain reasons for the safe handling of bacteria.
Describe how yeast growth rate can be increased, its optimum growth rate being controlled by: • food availability • temperature • pH • removal of waste products.	Describe how yeast growth rate doubles for every 10°C rise in temperature until the optimum is reached.
Describe the structure of viruses as: • a protein coat • surrounding a strand of genetic material. Understand that viruses: • can only reproduce in other living cells • only attack specific cells • may attack plant, bacterial or animal cells.	Explain how a virus reproduces, to include: • attaching itself to a specific host cell • injecting its genetic material into the cell • using the cell to make the components of new viruses • causing the host cell to split open to release the viruses.

Module B6: Beyond The Microscope

Item B6b: Harmful microorganisms

Summary: Despite giving a range of useful products, some microorganisms are dangerous to humans. Each year millions of deaths are directly caused by bacteria and viruses. The work of Lister, Pasteur and Fleming illustrates how uncertainties in scientific knowledge change over time and the role of the scientific community in validating these changes.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
	Understand that some microorganisms are pathogens. Describe how pathogens can enter the body, limited to: • nose (airborne microorganisms) • mouth (contaminated food and water) • skin (insect bites, cuts, infected needles) • reproductive organs (contact). Relate different types of microorganisms to the disease they can cause, limited to: • cholera and food poisoning, caused by bacteria • influenza and chickenpox, caused by viruses • athlete's foot caused by a fungus.
Research how aid agencies such as the Red Cross respond rapidly to an emergency. Research incidence of disease following a recent natural disaster.	Recall that diseases such as cholera and food poisoning can be a major problem following a natural disaster such as earthquakes and erupting volcanoes.
Compare the effectiveness of different antiseptics/ antibiotics using a culture of bacteria on an agar plate (by measuring and comparing the diameters of the halos).	Recognise that harmful bacteria can be controlled by antibiotics. Understand that bacteria can develop resistance to antibiotics.

Module B6: Beyond The Microscope

Item B6b: Harmful microorganisms

Links to other items: B1c: Staying healthy, B6a: Understanding microbes

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Understand how the transmission of diseases can be prevented, limited to disease transmitted by: • food • water • contact • airborne droplets. Describe the stages of an infectious disease, to include: • entry into the body • rapid growth, the incubation period • production of many toxins • appearance of symptoms such as fever.	Interpret data on the incidence of influenza, food poisoning and cholera.
Explain why natural disasters cause a rapid spread of diseases, to include: • damage to sewage systems and water supplies • damage to electrical supplies causing rapid food decay • displacement of people • disruption to health services.	
Describe the pioneering work of the following scientists in the treatment of disease, limited to: • Pasteur and the germ theory of disease • Lister and the development of antiseptics • Fleming and the discovery of penicillin. Describe how antiseptics and antibiotics are used in the control of disease. Recall that viruses are unaffected by antibiotics. Explain how some strains of bacteria are developing resistance to antibiotics by natural selection.	Explain the importance of various procedures in the prevention of antibiotic resistance to include: • only prescribing antibiotics when necessary • completion of the dose.

Module B6: Beyond The Microscope

Item B6c: Useful microorganisms

Summary: As we begin to understand how microorganisms work, we can develop new ways of using them as well as making existing processes more efficient.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Make yoghurt using freshly pasteurised milk and a starter culture of live yoghurt. Measure and record the pH of milk as it is converted to yoghurt using pH paper/pH meter/data logger. Consider adverts for 'pro-biotic' yoghurts.	Recall that some bacteria are useful in: • yoghurt making • cheese production • vinegar production • silage production • composting.
Brewing beer, cider or wine. A 'home brew' beer or wine kit can be used to demonstrate the principles of fermentation. Collect gas from fermenting sugar and test it for carbon dioxide. Carry out experiments to show how yeast activity is affected by temperature.	Describe fermentation as the production of alcohol, including wine and beer, by the breakdown of sugars by yeast in the absence of oxygen. Recall that a gas, carbon dioxide, is also produced during fermentation.
	Recall that some products of fermentation can be further treated to increase the alcohol concentration to produce spirits.

Module B6: Beyond The Microscope

Item B6c: Useful microorganisms

Links to other items: B3c: Respiration, B6a: Understanding microbes

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the main stages in making yoghurt, to include: • sterilisation of equipment • pasteurisation of milk • incubation of culture • sampling • addition of flavours, colours and packaging.	Describe the action of *Lactobacillus* bacteria in yogurt making, to include: • the breakdown of lactose in milk • the production of lactic acid.
Recall and use the word equation for fermentation (anaerobic respiration in yeast): glucose (sugar) → ethanol (alcohol) + carbon dioxide Describe the main stages in brewing beer or wine, to include: • extracting sugar from source material • adding yeast, keeping it warm • preventing entry of air and other microorganisms • clarifying/clearing, drawing off the wine/beer • pasteurising, casking or bottling.	Recall and use the balanced chemical equation for fermentation (anaerobic respiration): $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ Explain the implications for the fermentation process of yeast being able to undergo aerobic or anaerobic respiration. Interpret data on the breakdown of sugar by yeast in different conditions such as changing temperature and the presence or absence of oxygen. Describe what is meant by the term pasteurisation and explain why this needs to be done in the case of bottled beers.
Describe the process of distillation to increase the alcohol concentration, and understand that this commercial process needs licensed premises.	Understand how fermentation is limited by the effects of increasing levels of alcohol. Understand that different strains of yeast can tolerate different levels of alcohol.

Module B6: Beyond The Microscope

Item B6d: Biofuels

Summary: With problems of declining stocks of fossil fuels and long term problems of nuclear energy, many countries are developing cleaner fuels which need only simple technology. Many of these processes involve the use of microorganisms.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
	Explain how plants produce biomass. Recognise examples of fuels from biomass, to include: • alcohol • biogas • wood.
Research the use of biogas in Nepal. Design a biogas digester and display the plans as a chart. Research use of biogas in cities such as Newcastle and Leeds.	Understand why biogas (mainly methane) is an important energy resource in certain remote parts of the world lacking a mains electricity supply or mains sewage system. Recall that the rotting of organic material such as dead plants and animal waste: • occurs in marshes, septic tanks and animal digestive systems • produces a mixture of gases including methane • is caused by the action of bacteria. Recall that biogas can be produced on a large scale using a digester. Explain why methane being released from landfill sites is dangerous: it can burn or explode preventing use of the site for many years.
	Recall that alcohol: • can be made from yeast • can be used as a biofuel by mixing with petrol.

Module B6: Beyond The Microscope

Item B6d: Biofuels

Links to other items: B2g: Population and pollution, B4h: Farming

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe different methods of transferring energy from biomass, to include: • burning fast growing trees • fermenting biomass using bacteria or yeast. Given data, evaluate different methods of transferring energy from biomass. Describe the advantages of using biofuels, to include: • alternative sources to fossil fuels • no increase in greenhouse gas levels • no particulates produced.	Explain why the burning of biofuels does not cause a net increase in greenhouse gas levels if: • they are burnt at the same rate as the biomass is being produced • areas of land are not cleared of other vegetation in order to grow crops for biofuels. Explain how, in some areas, the use of large areas of land to produce biofuels is resulting in: • habitat loss • extinction of species.
Recall that biogas contains: • mainly methane • some carbon dioxide • traces of hydrogen, nitrogen and hydrogen sulfide. Describe how methane can be produced on a large scale using a continuous flow method of providing organic waste and removing the gas and remaining solids. Describe the uses of biogas, to include: • burning to generate electricity • burning to produce hot water and steam for heating systems • used as a fuel for vehicles. Describe how biogas production is affected by temperature.	Recall that biogas containing more than 50% methane can be burnt in a controlled way but a lower percentage of about 10% is explosive. Understand that biogas is a 'cleaner' fuel than diesel and petrol but does not contain as much energy as natural gas. Explain why biogas production is affected by temperature.
Recall that a mixture of petrol and alcohol: • is called gasohol • is used for cars in countries such as Brazil.	Understand why gasohol is more economically viable in countries that have ample sugar cane and small oil reserves.

Module B6: Beyond The Microscope

Item B6e: Life in soil

Summary: Life above ground is obvious. Life below ground is just as diverse and essential in maintaining the recycling of important elements and providing the correct conditions for plant growth. Without the action of soil life we would have to climb over dead dinosaur bodies to get to school and many important elements would be unavailable.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment to show that life is present in a soil sample (using lime water or bicarbonate indicator). Investigate the humus, air and water content of soil.	Describe the main components of soil as being: • different sized mineral particles • dead material • living organisms • air • water.
Identify soil fauna and flora using identification keys. Examine microscopic soil life using light and binocular microscopes.	Describe a typical food web in a soil, to include: • herbivores such as slugs, snails and wire worms • detritivores such as earthworms, millipedes and springtails • carnivores such as centipedes, spiders and ground beetles. Describe the role of bacteria and fungi as decomposers.
Compare the composition of different soils.	Explain why soil is important for the majority of plants.
Set up a wormery.	Recognise that earthworms can improve soil structure and fertility.

Module B6: Beyond The Microscope

Item B6e: Life in soil

Links to other items: B2b: Energy flow, B2c: Recycling, B4a: Ecology in the local environment, B4g: Decay

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the difference between a sandy soil and a clay soil in terms of particle size. Recall that loam is a soil that contains a mixture of clay and sand. Recall that if the dead material in soil is largely decomposed, it is called humus. Describe simple experiments to compare the humus, air and water content of different soils.	Explain how particle size affects the air content and permeability of soils. Explain the results of soil experiments in terms of mineral particle size and organic matter content.
Interpret data on soil food webs.	
Explain why some life in soil depends on a supply of oxygen and water. Explain the importance of humus in the soil, limited to: • decomposition to release minerals • increasing the air content.	Explain why aerating and draining will improve soils. Explain why neutralising acidic soils and mixing up soil layers is important.
Explain why earthworms are important to soil structure and fertility, to include: • burying organic material for decomposition by bacteria and fungi • aerating and draining the soil • mixing up soil layers • neutralising acidic soil.	Recognise the part played by Charles Darwin in highlighting the importance of earthworms in agriculture.

Module B6: Beyond The Microscope

Item B6f: Microscopic life in water

Summary: More than two thirds of the Earth's surface is covered by water, mostly sea water. Life in water is different from life on land yet it shows the same incredible variation. Some of this life is obvious, due to its size, but it all depends on microscopic plankton for a source of food. Since there seems to be so much water, we have unfortunately used it to dispose of waste causing extensive damage to aquatic life.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine microscopic life in pond water.	Recognise that there are a wide variety of microorganisms living in water.
Examine living *Daphnia* to observe internal structures such as its heart and digestive system.	Recognise that plankton are microscopic plants (phytoplankton) and microscopic animals (zooplankton). Recall that phytoplankton are capable of photosynthesis and are producers in aquatic food chains and webs. Understand that plankton: • have limited movement and so rely on water currents • show seasonal variations in numbers due to variations in light, temperature and minerals.
Research the effect of marine pollution on whale species and other marine organisms.	Recall that the variety and numbers of aquatic microorganisms can be affected by pollution and acid rain. Recognise various pollutants of water, to include: oil, sewage, PCBs, fertilisers, pesticides and detergents. Analyse data on water pollution to determine the pollution source.

Module B6: Beyond The Microscope

Item B6f: Microscopic life in water

Links to other items: B2b: Energy flow, B4a: Ecology in the local environment

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the advantages of life in water, limited to: • no problem of water shortage and dehydration • less variation in temperature • more support • easy disposal of waste products. Explain the disadvantages of life in water, limited to: • regulating water content • resistance to movement.	Explain the problems of water balance caused by osmosis. Describe the action of contractile vacuoles in microscopic animals such as amoeba.
Describe how factors affecting photosynthesis vary at different depths and in different seasons in water, to include: • light • temperature • minerals. Interpret data on seasonal fluctuations in phytoplankton and zooplankton.	Interpret data on marine food webs. Understand that 'grazing food webs' are most common in the oceans but some food chains rely on: • 'marine snow' • bacteria, deep in the ocean, acting as producers.
Explain how sewage and fertiliser run-off can cause eutrophication, to include: • rapid growth of algae • resulting death and decay • using up oxygen • causing the death of animals unable to respire. Describe how certain species of organisms are used as biological indicators for pH and oxygen levels.	Explain the accumulative, long term effect of PCBs and DDT on animals such as whales.

Module B6: Beyond The Microscope

Item B6g: Enzymes in action

Summary: Many effects of microorganisms are based on the enzymes they contain. Enzymes are specific and catalyse many reactions which are useful to humans. They enable reactions which normally take place at much higher temperatures to work at low temperatures (thus saving energy).

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Investigate the effectiveness of a biological washing powder in removing food stains. Plan or perform an investigation to find the effects of temperature, soaking time or concentration of washing powder solution on the efficiency of stain removal.	Describe everyday uses of enzymes, limited to: • biological washing powders and stain removers • cheese making and juice extraction • the preparation of medical products such as reagent sticks • altering the flavour of food products. Recall that biological washing powders do not work at high temperature and extremes of pH.
Demonstrate the use of 'clinistix' or 'dextrostix' to determine the glucose concentration of a series of 'spoof urines'. (glucose dissolved in a solution of water, a trace of marmite & 1 drop of washing up liquid so it looks like urine).	Describe how people with diabetes test their urine (using either Benedict's test or reagent strip sticks) for the presence of glucose.
Immobilise enzymes in alginate beads and investigate the effect on a substrate.	Recall how some enzymes can be immobilised: • in gel beads • on reagent sticks. Recall that immobilised enzymes on reagent sticks can be used to measure glucose levels in the blood.

Module B6: Beyond The Microscope

Item B6g: Enzymes in action

Links to other items: B3b: Proteins and mutations

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the enzymes in biological washing powders, to include: • amylases – to digest the carbohydrate starch • lipases – to digest fat and remove fatty stains • proteases – to digest protein and remove protein stains. Explain why biological washing powders work best at moderate temperatures.	Explain why the products of digestion will easily wash out of clothes, in terms of their solubility. Explain why biological washing powders may not work in acidic or alkaline tap water.
Describe how sucrose can be broken down by the use of an enzyme called sucrase (invertase). Recognise that, when sucrose is broken down by enzymes, the product is much sweeter making it useful to the food industry.	Explain how foods are sweetened using invertase: • invertase converts sucrose into glucose and fructose • these sugars are much sweeter than the sucrose • foods can therefore be sweetened without adding so much sugar (e.g. in low calorie foods).
Describe how enzymes can be immobilised in gel beads by: • mixing the enzyme with alginate • dropping the mixture into calcium chloride solution. Explain the advantages of immobilising enzymes, to include: • the mixture not becoming contaminated with the enzyme • immobilised enzymes in alginate beads can be used in continuous flow processing.	Explain the condition of lactose intolerance: • they cannot produce the enzyme lactase • so bacteria in the gut ferment lactose • fermentation produces diarrhoea and wind. Explain the principles behind the production of lactose-free milk for people with lactose intolerance, to include: • immobilised lactase converting lactose in milk into glucose and galactose • these simple sugars can then be absorbed.

Module B6: Beyond The Microscope

Item B6h: Gene technology

Summary: Biotechnology is "using life to make things". Genetic engineering has the potential to alter life on Earth in a very short time span by transferring genes from one organism to another. Genetic engineering is possible due to the availability of enzymes that can be used to manipulate DNA. The same enzymes can be used to produce DNA 'fingerprints'.

Suggested practical and research activities to select from	Assessable learning outcomes Foundation Tier only: low demand
Extract DNA from onions, kiwi fruit or wheat germ.	Define genetic engineering as altering the genetic code of an organism by inserting genes. Understand that genes from one organism can work in another. Describe the process of genetic engineering: • removing a gene from one organism • inserting it into another organism • the gene works in the new organism.
Use gene splicing kits (using a luminous gene from jelly fish).	Recall that bacteria can be genetically engineered to produce useful human proteins, to include: • insulin • human growth hormone. Describe how these bacteria can be grown in large fermenters to produce large quantities of proteins.
Examine DNA 'fingerprinting' results. Use DNA 'fingerprinting kits' (using lambda phage DNA).	Recall that a person's DNA can be used to produce a DNA 'fingerprint'. Understand that this can be used to identify a person because a person's DNA is unique.

Module B6: Beyond The Microscope

Item B6h: Gene technology

Links to other items: B3a: Molecules of life, B3g: New genes for old

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall that the new type of organism produced by genetic engineering is called a transgenic organism. Describe the main stages in genetic engineering: • identification of a desired gene in one organism • removal of gene from DNA • cutting open the DNA in another organism • inserting the new gene into the DNA • gene works in transgenic organism • transgenic organism can be cloned to produce identical copies. Recall that the cutting and inserting of DNA is achieved using enzymes.	Explain why genes from one organism can work in another, making genetic engineering possible. Explain how: • restriction enzymes cut open DNA to leave 'sticky ends' • the 'sticky ends' allow ligase enzymes to rejoin DNA strands.
Describe how bacteria can be used in genetic engineering to produce human insulin, to include: • the gene for producing human insulin is cut out of human DNA • a loop of bacterial DNA is cut open • the insulin gene is inserted into the loop • the loop is inserted into a bacterium • the bacteria are then able to produce insulin • transgenic bacteria are cultured by cloning • large quantities of insulin are harvested.	Recall that bacteria have loops of DNA called plasmids in their cytoplasm. Explain how, because these plasmids can be taken up by bacteria, they can be used as 'vectors' in genetic engineering. Recall that assaying techniques are used to check that the new gene has been correctly transferred.
Interpret data on DNA 'fingerprinting' for identification. Describe the arguments for and against the storage of DNA 'fingerprints'.	Describe the stages in the production of a DNA 'fingerprint', to include: • extraction of DNA from sample • fragmentation of DNA using restriction enzymes • separation using electrophoresis • visualising pattern using a radioactive probe.

4 Assessment of GCSE Biology B

4.1 Overview of the assessment in GCSE Biology B

To claim the qualification GCSE Biology B (J263) candidates will need to complete all three units.

GCSE Biology B J263	
Unit B731: *Biology modules B1, B2, B3*	
35% of the total GCSE 1 hour 15 mins written paper 75 marks	This question paper: • is offered in Foundation and Higher Tiers • focuses on modules B1, B2 and B3 • uses structured questions (candidates answer all questions) • assesses the quality of written communication.
Unit B732: *Biology modules B4, B5, B6*	
40% of the total GCSE 1 hour 30 mins written paper 85 marks	This question paper: • is offered in Foundation and Higher Tiers • focuses on modules B4, B5 and B6 • includes a 10 mark data response section which assesses AO3 (analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence) • uses structured questions (candidates answer all questions) • assesses the quality of written communication.
Unit B733: *Biology controlled assessment*	
25% of the total GCSE Controlled assessment Approximately 7 hours 48 marks	This unit: • comprises one assessment task, split into three parts • is assessed by teachers, internally standardised and then externally moderated by OCR • assesses the quality of written communication.

4.2 Tiers

All written papers are set in one of two tiers: Foundation Tier and Higher Tier. Foundation Tier papers assess grades G to C and Higher Tier papers assess Grades D to A*. An allowed grade E may be awarded on the Higher Tier components.

In Units B731 and B732, candidates are entered for an option in either the Foundation Tier or the Higher Tier. Unit B733 (controlled assessment) is not tiered.

Candidates may enter for either the Foundation Tier or Higher Tier in each of the externally assessed units. So, a candidate may take, for example B731/F and B732/H.

4.3 Assessment objectives (AOs)

Candidates are expected to demonstrate their ability to:

AO1	recall, select and communicate their knowledge and understanding of biology
AO2	apply skills, knowledge and understanding of biology in practical and other contexts
AO3	analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence.

4.3.1 AO weightings – GCSE Biology B

The relationship between the units and the assessment objectives of the scheme of assessment is shown in the following grid:

Unit	% of GCSE			
	AO1	AO2	AO3	Total
Unit B731: *Biology modules B1, B2, B3*	16	17.5	1.5	35
Unit B732: *Biology modules B4, B5, B6*	16	17.5	6.5	40
Unit B733: *Biology controlled assessment*	2	5	18	25
Total	34	40	26	100

4.4 Grading and awarding grades

GCSE results are awarded on the scale A* to G. Units are awarded a* to g. Grades are indicated on certificates. However, results for candidates who fail to achieve the minimum grade (G or g) will be recorded as *unclassified* (U or u) and this is **not** certificated.

Most GCSEs are unitised schemes. When working out candidates' overall grades OCR needs to be able to compare performance on the same unit in different series when different grade boundaries may have been set, and between different units. OCR uses a Uniform Mark Scale to enable this to be done.

A candidate's uniform mark for each unit is calculated from the candidate's raw mark on that unit. The raw mark boundary marks are converted to the equivalent uniform mark boundary. Marks between grade boundaries are converted on a pro rata basis.

When unit results are issued, the candidate's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit, e.g. 60/100.

The specification is graded on a Uniform Mark Scale. The uniform mark thresholds for each of the assessments are shown below:

(GCSE) Unit Weighting	Maximum Unit Uniform Mark	Unit Grade								
		a*	a	b	c	d	e	f	g	u
25%	100	90	80	70	60	50	40	30	20	0
35% F	97	–	–	–	84	70	56	42	28	0
35% H	140	126	112	98	84	70	63	–	–	0
40% F	111	–	–	–	96	80	64	48	32	0
40% H	160	144	128	112	96	80	72	–	–	

Higher Tier candidates who fail to gain a 'd' grade may achieve an "allowed e". Higher Tier candidates who miss the allowed grade 'e' will be graded as 'u'.

A candidate's uniform marks for each unit are aggregated and grades for the specification are generated on the following scale:

Qualification	Max Uniform Mark	Qualification Grade								
		A*	A	B	C	D	E	F	G	U
GCSE	400	360	320	280	240	200	160	120	80	0

The written papers will have a total weighting of 75% and controlled assessment a weighting of 25%.

A candidate's uniform mark for each paper will be combined with the uniform mark for the controlled assessment to give a total uniform mark for the specification. The candidate's grade will be determined by the total uniform mark.

4.5 Grade descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performance in others.

The grade descriptors have been produced by the regulatory authorities in collaboration with the awarding bodies.

4.5.1 Grade F

Candidates recall, select and communicate limited knowledge and understanding of biology. They show a limited understanding that scientific advances may have ethical implications, benefits and risks. They recognise simple inter-relationships between biology and society. They use limited scientific and technical knowledge, terminology and conventions, showing some understanding of scale in terms of time, size and space.

They apply skills, including limited communication, mathematical, technical and observational skills, knowledge and understanding in practical and some other contexts. They recognise and use hypotheses, evidence and explanations and can explain straightforward models of phenomena, events and processes. They use a limited range of methods, sources of information and data to address straightforward scientific questions, problems and hypotheses.

Candidates interpret and evaluate limited quantitative and qualitative data and information from a narrow range of sources. They can draw elementary conclusions having collected limited evidence.

4.5.2 Grade C

Candidates recall, select and communicate secure knowledge and understanding of biology. They demonstrate understanding of the nature of biology and its principles and applications and the relationship between biology and society. They understand that scientific advances may have ethical implications, benefits and risks. They use scientific and technical knowledge, terminology and conventions appropriately, showing understanding of scale in terms of time, size and space.

They apply appropriate skills, including communication, mathematical, technical and observational skills, knowledge and understanding in a range of practical and other contexts. They show understanding of the relationships between hypotheses, evidence, theories and explanations and use models, including mathematical models, to describe abstract ideas, phenomena, events and processes. They use a range of appropriate methods, sources of information and data, applying their skills to address scientific questions, solve problems and test hypotheses.

Candidates analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand the limitations of evidence and use evidence and information to develop arguments with supporting explanations. They draw conclusions based on the available evidence.

4.5.3 Grade A

Candidates recall, select and communicate precise knowledge and detailed understanding of biology. They demonstrate a comprehensive understanding of the nature of biology, its principles and applications and the relationship between biology and society. They understand the relationships between scientific advances, their ethical implications and the benefits and risks associated with them. They use scientific and technical knowledge, terminology and conventions appropriately and consistently showing a detailed understanding of scale in terms of time, size and space.

They apply appropriate skills, including communication, mathematical, technical and observational skills, knowledge and understanding effectively in a wide range of practical and other contexts. They show a comprehensive understanding of the relationships between hypotheses, evidence, theories and explanations and make effective use of models, including mathematical models, to explain abstract ideas, phenomena, events and processes. They use a wide range of appropriate methods, sources of information and data consistently, applying relevant skills to address scientific questions, solve problems and test hypotheses.

Candidates analyse, interpret and critically evaluate a broad range of quantitative and qualitative data and information. They evaluate information systematically to develop arguments and explanations taking account of the limitations of the available evidence. They make reasoned judgments consistently and draw detailed, evidence-based conclusions.

4.6 Quality of written communication

Quality of written communication is assessed in all units and is integrated in the marking criteria.

Candidates are expected to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- present information in a form that suits its purpose
- use an appropriate style of writing and, where appropriate, specialist terminology.

Questions assessing quality of written communication will be indicated by a pencil icon (✎).

Controlled assessment in GCSE Biology B

5

This section provides general guidance on controlled assessment: what controlled assessment tasks are, when and how they are available; how to plan and manage controlled assessment and what controls must be applied throughout the process. More support can be found on the OCR website .

Teaching and Learning

Controlled assessment is designed to be an integral part of teaching and learning. There are many opportunities in teaching and learning to develop skills and use a variety of appropriate materials and equipment. These opportunities allow students to practise a wide range of tasks, and teachers can discuss and comment on performance as appropriate.

When all necessary teaching and learning has taken place and teachers feel that candidates are ready for assessment, candidates can be given the appropriate controlled assessment task.

5.1 Controlled assessment tasks

All controlled assessment tasks are set by OCR, are published on Interchange, and may only be submitted in the June examination series. Each year a choice of two tasks will be valid for submission. The number of tasks attempted by a candidate is at the discretion of the centre, but the results of only one may be submitted.

Each task will be valid for submission in a single examination series only. This will be clearly marked on the front cover of each task. Centres must ensure that candidates undertake a task applicable to the required year of submission by checking carefully the examination dates of the tasks on Interchange. Tasks will not be valid for submission in any examination series other than that indicated.

Each year, two new controlled assessment tasks will be made available on Interchange from 1st June for certification in the following academic year, two years ahead of the examination series for which the tasks are to be submitted. Tasks will be removed upon expiry. Guidance on how to access controlled assessment tasks from Interchange is available on the OCR website: www.ocr.org.uk.

The same OCR controlled assessment task must **NOT** be used as practice material and then as the actual live assessment material.

5.2 Nature of controlled assessment tasks

5.2.1 Introduction to controlled assessment

Controlled assessment tasks have been designed to be an integral part of the teaching of the course. The practical activities will be based on the specification content. It is expected that candidates will complete the task at the appropriate point in the teaching of the specification content.

Opportunities to develop the practical skills required for this task are highlighted in the content of the specification. It is essential that candidates have some advance practice in these skills so that they can maximise their attainment. Candidates will need to take part in a planned learning programme that covers the underpinning knowledge and skills of the unit prior to undertaking the task.

The controlled assessment unit requires the completion of one assessment task. Each task is divided into three parts which are linked into an overall theme. The three parts should be taken in the order of Part 1, Part 2 and Part 3. Stimulus material will be provided which will introduce candidates to the task and direct the work they produce.

Part 1 – Research and collecting secondary data

Part 1 requires candidates to plan and carry out research. The Part 1 stimulus material introduces the task and provides guidance for the research. The research may be conducted either in class or as a homework exercise. The information collected is required for Parts 2 and 3.

Part 2 – Planning and collecting primary data

Part 2 requires candidates to develop a hypothesis in response to the Part 2 stimulus material and to plan and carry out an investigation to collect primary data to test their hypothesis. Collecting the data, as well as an assessed skill, will help candidates in Part 3 of the task by:

- enhancing their awareness of the practical techniques involved
- focusing on the quality of the data collected
- making them aware of the risks and necessary safety precautions.

Part 3 – Analysis and evaluation

Part 3 requires candidates to process and analyse the results from their research (Part 1) and their primary data (Part 2). They will also be required to evaluate their data and the methods used to collect it, and draw and justify a conclusion. Candidates will be guided by questions in an answer booklet.

5.2.2 Summary of task in Unit B733

Assessment Task	Task Marks	Weighting
Biology controlled assessment task (Part 1, Part 2 and Part 3)	48	25%

5.3 Planning and managing controlled assessment

Controlled assessment tasks are available at an early stage to allow planning time prior to delivery. It is anticipated that candidates will spend a total of about 7 hours in producing the work for this unit. Candidates should be allowed sufficient time to complete the tasks.

While the wording of the stimulus material and questions must remain unchanged, practical aspects of these tasks can be adapted so that they allow the use of resources available to the centre, including the availability of equipment and materials for practical work.

Where controlled assessment tasks are adapted by centres this must be in ways that will not put at risk the opportunity for candidates to meet the marking criteria, including the chance to gain marks at the highest level.

Suggested steps and timings are included below, with guidance on regulatory controls at each step of the process. Teachers must ensure that control requirements indicated below are met throughout the process.

The parts of the task should be taken in the order of Part 1, Part 2 and Part 3. Candidates' work for Parts 1 and 2 should be collected on completion and returned to the candidates for Part 3.

5.3.1 Part 1 – Research and collecting secondary data

- Research activities **1.5 – 2 hours**

The teacher should introduce Part 1 of the task, including time allocations, an outline of the task, the methods of work, control requirements and deadlines. The teacher may introduce the stimulus material to be used in Part 1.

In Part 1, the research stage, a limited level of control is required. Candidates can undertake the research part of the process without direct teacher supervision. Candidates should be provided with access to resources and materials which allow them to access the full range of marking criteria. The work of individual candidates may be informed by working with others; however, candidates must produce an individual response for use in the Part 2 and Part 3 supervised sessions. During the research stage candidates can be given support and guidance. They should be provided with the stimulus which provides the topic for the research. Teachers can explain the task, advise on how the task could be approached, and advise on resources.

Research methods can include fieldwork, internet or paper-based research, questionnaires, audio and video files etc. It is essential that any material directly used from a source is appropriately and rigorously referenced. Further advice and guidance regarding the research stage is provided in the Guide to controlled assessment for GCSE Gateway Biology B. Research activities can be lesson or homework time.

At the end of Part 1, candidates will have individually written up their research and collected their research data. This should be collected in and retained by the teacher and returned to the candidate when completing Part 2 and Part 3.

5.3.2 Part 2 – Planning and collecting primary data

- Planning **1.5 – 2 hours**
- Practical **1 hour**

The teacher should introduce Part 2 of the task, including time allocations, an outline of the task, the methods of work, control requirements and deadlines. The teacher may introduce the stimulus material to be used in Part 2. Candidates also need access to their individual work and research from Part 1.

In Part 2 candidates are required to formulate a hypothesis, plan an investigation, provide a risk assessment of their plan and carry out the experiment they have planned to collect primary data. Candidates may work in groups of no more than three to develop the plan and carry out the investigation. However, candidates' hypothesis, plan and results must be recorded individually in supervised lesson time.

Teachers should supervise the practical work in accordance with normal practice, to ensure safety procedures (see Appendix D for further guidance). Guidance regarding levels of support is provided in the *Guide to controlled assessment* for GCSE Gateway Biology B. This includes guidance on adapting the tasks for the equipment and materials available to the centre. Candidates will need to be provided with materials and equipment to allow them to access the full range of the marking criteria. Further specific guidance will also be provided with each task.

The work of candidates should be collected in and retained by the teacher and returned to the candidate when completing Part 3.

5.3.3 Part 3 – Analysis and evaluation

- Analysis and evaluation **1.5 – 2 hours**

The teacher should introduce Part 3 of the task, including time allocations, an outline of the task, the methods of work, control requirements and deadlines. The teacher may introduce the answer booklet to be used in Part 3.

In Part 3 candidates must work independently under supervised conditions as this part is under high control.

The answer booklet for Part 3 requires candidates to process and analyse the secondary data and information they have collected (Part 1) and the results of their investigation (Part 2). Candidates will need access to their individual responses from Part 1 and Part 2. Questions then guide candidates to evaluate their data and the methods used to collect it, and draw and justify a conclusion.

In processing the data candidates will have opportunities to use mathematical and graphical skills. Candidates must not be instructed or advised in these areas during the task.

On completion of the task, the loose leaf pages for Parts 1 and 2 should be collated and attached to each candidate's Part 3 answer booklet.

5.3.4 Supervision by the teacher

Candidates must work individually under limited supervision to:

- record their findings from secondary research in Part 1
- record their hypothesis, experimental plan and risk assessment in Part 2
- record their experimental results in Part 2.

Candidates must work independently under supervised conditions to:

- complete the answer booklet in Part 3.

The work submitted for moderation must be produced under controlled conditions, which means under teacher supervision: teachers must be able to authenticate the work and the candidates must acknowledge and reference any sources used. As writing up of each part is carried out over several sessions, work must be collected in between sessions. The Part 2 stimulus material and Part 3 answer booklet must not be taken out of the supervised sessions.

When supervising tasks, teachers are expected to:

- exercise continuing supervision of work in order to monitor progress and to prevent plagiarism
- provide guidance on the use of information from other sources to ensure that confidentiality and intellectual property rights are maintained
- exercise continuing supervision of practical work to ensure essential compliance with Health and Safety requirements
- ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the specified marking criteria and procedures.

Teachers must not provide templates, model answers or feedback on drafts. They may give generic, informal feedback while the task is being completed but may not indicate what candidates need to do to improve their work.

5.3.5 Presentation of the work

Candidates must observe the following procedures when producing their final piece of work for the controlled assessment tasks:

- responses to Parts 1 and 2 will be on loose leaf paper. Tables and graphs may be produced using appropriate ICT. These should all be attached to the answer booklet for Part 3
- any copied material must be suitably acknowledged
- quotations must be clearly marked and a reference provided wherever possible
- work submitted for moderation must be marked with the:
  - centre number
  - centre name
  - candidate number
  - candidate name
  - unit code and title
  - task title.

Work submitted on paper for moderation must be secured by treasury tags. Work submitted in digital format (CD or online) must be in a suitable file structure as detailed in Appendix A at the end of this specification.

5.4 Marking and moderating controlled assessment

All controlled assessed tasks are marked by the centre assessor(s) using OCR marking criteria and guidance.

This corresponds to a medium level of control.

5.4.1 Applying the marking criteria

The starting point for marking the tasks is the marking criteria (see Section 5.4.4 *Marking criteria for controlled assessment tasks* below). The criteria identify levels of performance for the skills, knowledge and understanding that the candidate is required to demonstrate. Additional guidance for each task will be provided alongside the generic marking criteria. At INSET training events and in support materials, OCR will provide exemplification through real or simulated candidate work which will help to clarify the level of achievement that assessors should be looking for when awarding marks.

5.4.2 Use of 'best fit' approach to the application of the marking criteria

A controlled assessment task should only be marked when all three parts have been completed. The task should be marked by teachers according to the marking criteria using a 'best fit' approach.

For each of the skill qualities, teachers should first use their professional judgement to select one of the four band descriptors provided in the marking grid that most closely describes the quality of the work being marked.

Following the selection of the band descriptor, the most appropriate mark within the band descriptor is chosen. Teachers should use the following guidance to select this mark:

- where the candidate's work *convincingly* meets the statement, the higher mark should be awarded (for example the 3 – 4 marks band is chosen and 4 marks are awarded)
- where the candidate's work *just* meets the statement, the lower mark should be awarded (for example the 3 – 4 marks band is chosen and 3 marks are awarded).

Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

Teachers should use the full range of marks available to them and award *full* marks in any band for work which fully meets that descriptor. This is work which is 'the best one could expect from candidates working at that level'.

The final mark for the candidate for the controlled assessment unit is out of a total of *48* and is found by totalling the marks for each skill quality. Only one mark out of a total of 48 will be required for submission for the unit.

There should be clear evidence that work has been attempted and some work produced. If a candidate submits no work for this internally assessed unit, then the candidate should be indicated as being absent from that unit. If a candidate completes any work at all for an internally assessed unit, then the work should be assessed according to the marking criteria and the appropriate mark awarded, which may be zero.

5.4.3 Annotation of candidates' work

Each piece of internally assessed work should show how the marks have been awarded in relation to the marking criteria.

The writing of comments on candidates' work provides a means of communication between teachers during the internal standardisation and with the moderator if the work forms part of the moderation sample.

5.4.4 Marking criteria for controlled assessment tasks

Assessment objectives (AOs)

Each of the aspects to be assessed addresses one or more of the assessment objectives and these are shown in the marking criteria. The overall balance is shown in the table below:

Assessment objective		Total
AO1:	Recall, select and communicate their knowledge and understanding of science	5
AO2:	Apply skills, knowledge and understanding of science in practical and other contexts	10
AO3:	Analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence	33
	Total	**48**

Assessment of the quality of written communication

The quality of written communication is assessed in Parts 2 and 3 of this controlled assessment and indicated by a pencil symbol (✎) for the information of candidates.

Skill quality	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Researching: collect secondary data including the use of appropriate technology.	Some information collected and used from at least two sources.	Relevant information collected from at least three sources; information presented clearly and all sources identified.	Range of relevant sources identified and judgement used to select those appropriate to the task. Information collated and presented clearly in appropriate formats including a full bibliography.	AO1 – 1 AO2 – 3 AO3 – 2
Planning: develop hypotheses and plan practical ways to test them.	Simple hypothesis or prediction relates to the data or information provided but does not identify a trend or pattern to be investigated. Outline plan includes equipment and techniques to be used. Plan provides a 'fair test'. No evidence of modifications of plan during the data collection phase. Plan shows limited structure with errors in spelling and punctuation.	Hypothesis provides a limited scientific explanation of the data or information provided. Plan gives sufficient detail for experiment to be repeated, including choices of: equipment and techniques; range and number of data points for the independent variable; number of replicates; other variables to be controlled with the aim of collecting quality data. Some consideration given to how errors will be minimised. No evidence of modifications of plan during the data collection phase. Plan structured clearly with occasional errors in spelling and punctuation.	Complex hypothesis provides a complete scientific explanation of the data or information provided and is capable of investigation. Comprehensive plan shows scientific understanding in making appropriate choices of: equipment, including resolution, and techniques; range and number of data points for the independent variable; number of replicates; control of all other variables with the aim of collecting accurate data. Detailed consideration given to: how errors will be minimised; variables which cannot be controlled. Where appropriate, reasoned modifications made to the plan as evidence is collected. Plan structured coherently with few, if any, errors in grammar, punctuation and spelling.	AO1 – 1 AO2 – 3 AO3 – 2
Collecting data: collect primary data including the use of appropriate technology.	Results recorded clearly but not in an appropriate format.	Results tabulated to include all data expected, though not in the most appropriate format. Headings given but units not always correct.	Results tabulated clearly and logically, including use of correct headings and units; all data expected recorded to appropriate levels of precision.	AO1 – 2 AO2 – 4

0 marks = no response or no response worthy of credit

Skill quality	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Managing risk: manage risks when carrying out practical work including risk assessment.	Limited understanding of risks in procedures with only standard laboratory safety features mentioned. Some teacher intervention required to ensure safety.	Some risks in procedures analysed and some specific responses suggested to reduce risks. Risks managed successfully with no significant incidents or accidents and no requirement for teacher intervention.	All significant risks in the plan evaluated. Reasoned judgments made to reduce risks by use of appropriate specific responses. Risks managed successfully with no incidents or accidents and no requirement for teacher intervention.	AO3 – 6
Processing data: process primary and secondary data including the use of appropriate technology.	Some evidence of processing quantitative data: data presented as simple charts or graphs with some errors in scaling or plotting; use of one simple mathematical technique.	Graphical and mathematical techniques used to reveal patterns in the data: charts or graphs used to display data in an appropriate way, allowing some errors in scaling or plotting; correct use of more than one simple mathematical technique.	Appropriate graphical and mathematical techniques used to reveal patterns in the data: type of graph, scales and axes selected and data plotted accurately, including where appropriate a line of best fit; correct use of complex mathematical techniques where appropriate; appropriate quantitative treatment of level of uncertainty of data.	AO3 – 6
Analysing and interpreting: analyse and interpret primary and secondary data.	At least one trend/pattern identified and outlined correctly; an attempt is made to interpret the information linking primary and secondary data/information.	Main trend(s)/pattern(s) described and interpreted with reference to quantitative data and scientific knowledge and understanding, with some errors; reasoned comparison between primary and secondary data/information; any anomalous results identified correctly and implications discussed.	All trend(s)/pattern(s) described and interpreted correctly with reference to quantitative data and relevant scientific knowledge and understanding; links between primary and secondary data/information evaluated; level of uncertainty of the evidence analysed.	AO3 – 6

0 marks = no response or no response worthy of credit

Skill quality	1 – 2 marks	3 – 4 marks	5 – 6 marks	AO
Evaluating: review methodology to assess fitness for purpose.	Relevant comments made about the quality of the data and the method used. Answer is simplistic with limited use of specialist terms.	Comments made on the quality of the data including accuracy and sources of error, linked to the method of collection; limitations in the method of data collection identified and suggestions for improvement given. Information is relevant and presented in a structured format. Specialist terms are for the most part used appropriately.	Detailed and critical consideration given to the data and methods used to obtain them: sources of error and quality of the data discussed and explained, including accuracy, repeatability and uncertainty; limitations of the method identified and suggestions for improvements justified. Information is relevant, clear, organised and presented in a coherent format. Specialist terms are used appropriately.	AO1 – 1 AO3 – 5
Justifying a conclusion: draw evidence-based conclusions; review hypotheses in light of outcomes.	Conclusion given and hypothesis reviewed using the data collected. Answers simplistic with little scientific understanding.	Conclusion given and justified and hypothesis reviewed based on an analysis of the data and information from research and investigation, demonstrating an understanding of the underpinning science.	Conclusion given and justified and hypothesis reviewed, based on a critical analysis of the data and information from research and investigation, and clearly linked to relevant scientific knowledge and understanding.	AO3 – 6

0 marks = no response or no response worthy of credit

5.4.5 Authentication of work

Teachers must be confident that the work they mark is the candidate's own. This does not mean that a candidate must be supervised throughout the completion of all work but the teacher must exercise sufficient supervision, or introduce sufficient checks, to be in a position to judge the authenticity of the candidate's work.

Wherever possible, the teacher should discuss work-in-progress with candidates. This will not only ensure that work is underway in a planned and timely manner but will also provide opportunities for assessors to check authenticity of the work and provide general feedback.

Candidates must not plagiarise. Plagiarism is the submission of another's work as one's own and/or failure to acknowledge the source correctly. Plagiarism is considered to be malpractice and could lead to the candidate being disqualified. Plagiarism sometimes occurs innocently when candidates are unaware of the need to reference or acknowledge their sources. It is therefore important that centres ensure that candidates understand that the work they submit must be their own and that they understand the meaning of plagiarism and what penalties may be applied. Candidates may refer to research, quotations or evidence but they must list their sources. The rewards from acknowledging sources, and the credit they will gain from doing so, should be emphasised to candidates as well as the potential risks of failing to acknowledge such material.

Both candidates and teachers must declare that the work is the candidate's own:

- **each candidate** must sign a declaration before submitting their work to their teacher. A candidate authentication statement that can be used is available to download from the OCR website. These statements should be retained within the centre until all enquiries about results, malpractice and appeals issues have been resolved. **A mark of zero must be recorded if a candidate cannot confirm the authenticity of their work**
- **teachers** are required to declare that the work submitted for internal assessment is the candidate's own work by sending the moderator a centre authentication form (CCS160) for each unit at the same time as the marks. If a centre fails to provide evidence of authentication, **we will set the mark for that candidate(s) to Pending (Q) for that component until authentication can be provided.**

5.5 Internal standardisation

It is important that all internal assessors of this controlled assessment work to common standards. Centres must ensure that the internal standardisation of marks across assessors and teaching groups takes place using an appropriate procedure.

This can be done in a number of ways. In the first year, reference material and OCR training meetings will provide a basis for centres' own standardisation. In subsequent years, this, or centres' own archive material, may be used. Centres are advised to hold preliminary meetings of staff involved to compare standards through cross-marking a small sample of work. After most marking has been completed, a further meeting at which work is exchanged and discussed will enable final adjustments to be made.

5.6 Submitting marks and authentication

All work for controlled assessment is marked by the teacher and internally standardised by the centre. Marks are then submitted to OCR **and** your moderator: refer to the OCR website for submission dates of the marks to OCR.

There should be clear evidence that work has been attempted and some work produced. If a candidate submits no work for an internally assessed component, then the candidate should be indicated as being absent from that component. If a candidate completes any work at all for an internally assessed component, then the work should be assessed according to the internal assessment objectives and marking instructions and the appropriate mark awarded, which may be zero.

The centre authentication form (CCS160) must be sent to the moderator with the marks.

5.7 Submitting samples of candidate work

5.7.1 Sample requests

Once you have submitted your marks, your exams officer will receive an email requesting a moderation sample. Samples will include work from across the range of attainment of the candidates' work.

The sample of work which is presented to the moderator for moderation must show how the marks have been awarded in relation to the marking criteria defined in Section 5.4.4.

When making your entries, the entry option specifies how the sample for each unit is to be submitted. For each of these units, all candidate work must be submitted using the **same entry option**. It is not possible for centres to offer both options for a unit within the same series. You can choose different options for different units. Please see the Section 8.2.1 for entry codes.

5.7.2 Submitting moderation samples via post

The sample of candidate work must be posted to the moderator within three days of receiving the request. You should use one of the labels provided to send the candidate work.

We would advise you to keep evidence of work submitted to the moderator, e.g. copies of written work or photographs of practical work. You should also obtain a certificate of posting for all work that is posted to the moderator.

5.7.3 Submitting moderation samples via the OCR Repository

The OCR Repository is a secure website for centres to upload candidate work and for assessors to access this work digitally. Centres can use the OCR Repository for uploading marked candidate work for moderation.

Centres can access the OCR Repository via OCR Interchange, find their candidate entries in their area of the Repository, and use the Repository to upload files (singly or in bulk) for access by their moderator.

The OCR Repository allows candidates to send evidence in electronic file types that would normally be difficult to submit through postal moderation; for example multimedia or other interactive unit submissions.

The OCR GCSE Biology B unit B733 can be submitted electronically to the OCR Repository via Interchange: please check Section 8.2.2 for unit entry codes for the OCR Repository.

There are three ways to load files to the OCR Repository:

1. Centres can load multiple files against multiple candidates by clicking on 'Upload candidate files' in the Candidates tab of the Candidate Overview screen.

2. Centres can load multiple files against a specific candidate by clicking on 'Upload files' in the Candidate Details screen.

3. Centres can load multiple administration files by clicking on 'Upload admin files' in the Administration tab of the Candidate Overview screen.

The OCR Repository is seen as a faster, greener and more convenient means of providing work for assessment. It is part of a wider programme bringing digital technology to the assessment process, the aim of which is to provide simpler and easier administration for centres.

Instructions for how to upload files to OCR using the OCR Repository can be found on OCR Interchange.

5.8 External moderation

The purpose of moderation is to ensure that the standard of the award of marks for work is the same for each centre and that each teacher has applied the standards appropriately across the range of candidates within the centre.

At this stage, if necessary, centres may be required to provide an additional sample of candidate work (if marks are found to be in the wrong order) or carry out some re-marking. If you receive such a request, please ensure that you respond as quickly as possible to ensure that your candidates' results are not delayed.

6.1 Free resources available from the OCR website

The following materials will be available on the OCR website:

- GCSE Biology B Specification
- specimen assessment materials and mark schemes
- Guide to controlled assessment
- sample controlled assessment materials
- exemplar candidate work
- Teachers' Handbook
- sample schemes of work and lesson plans

Essential FREE support services including:

- INSET training – for information visit www.gcse-science.com
- Interchange – a completely secure, free website to help centres reduce administrative tasks at exam time http://www.ocr.org.uk/interchange
- e-alerts – register now for regular updates at www.ocr.org.uk/2011signup
- Active Results – detailed item level analysis of candidate results.

6.2 Other resources

OCR offers centres a wealth of high quality published support with a choice of 'Official Publisher Partner' and 'Approved Publication' resources, all endorsed by OCR for use with OCR specifications.

6.2.1 Publisher partners

OCR works in close collaboration with publisher partners to ensure you have access to:

- published support materials available when you need them, tailored to OCR specifications
- high quality resources produced in consultation with OCR subject teams, which are linked to OCR's teacher support materials

Collins is the publisher partner for OCR GCSE Additional Science B.

Collins is working with a team of experienced authors to provide resources which will help you deliver the new OCR GCSE Gateway Science specifications.

With Collins New GCSE Science you can:

Explain

- be sure you're delivering the new specification with content organised and written to match the specifications
- deliver outstanding lessons every time with differentiated lesson plans that include high quality plenaries to check effectiveness of every lesson and expert guidance on how to make a good lesson outstanding

Explore

- explore Science as it happens in the real world through interactive videos and animations in Interactive Books and How Science Works integrated throughout the series
- emphasise how science is relevant with engaging facts throughout and activities based on the book Bad Science, by Ben Goldacre

Excel

- help your students excel with plenty of practice questions that provide extra support for the quality of written communication
- raise standards with more questions than ever before designed to stretch and challenge high achievers.

6.2.2 Endorsed publications

OCR endorses a range of publisher materials to provide quality support for centres delivering its qualifications. You can be confident that materials branded with OCR's 'Official Publishing Partner' or 'Approved publication' logos have undergone a thorough quality assurance process to achieve endorsement. All responsibility for the content of the publisher's materials rests with the publisher.

These endorsements do not mean that the materials are the only suitable resources available or necessary to achieve an OCR qualification.

6.3 Training

OCR will offer a range of support activities for all practitioners throughout the lifetime of the qualification to ensure they have the relevant knowledge and skills to deliver the qualification.

Please see Event Booker for further information.

6.4 OCR support services

6.4.1 Active Results

Active Results is available to all centres offering OCR's GCSE Biology B specifications.

Active Results is a free results analysis service to help teachers review the performance of individual candidates or whole schools.

Data can be analysed using filters on several categories such as gender and other demographic information, as well as providing breakdowns of results by question and topic.

Active Results allows you to look in greater detail at your results:

- richer and more granular data will be made available to centres including question level data available from e-marking
- you can identify the strengths and weaknesses of individual candidates and your centre's cohort as a whole
- our systems have been developed in close consultation with teachers so that the technology delivers what you need.

Further information on Active Results can be found on the OCR website.

6.4.2 OCR Interchange

OCR Interchange has been developed to help you to carry out day-to-day administration functions online, quickly and easily. The site allows you to register and enter candidates online. In addition, you can gain immediate and free access to candidate information at your convenience.
Sign up on the OCR website.

7.1 Equality Act information relating to GCSE Biology B

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised GCSE qualification and subject criteria were reviewed by the regulators in order to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments and to demonstrate what they know and can do. For this reason, very few candidates will have a complete barrier to the assessment. Information on reasonable adjustments is found in *Access Arrangements, Reasonable Adjustments and Special Consideration* by the Joint Council www.jcq.org.uk.

Candidates who are unable to access part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award based on the parts of the assessment they have taken.

The access arrangements permissible for use in this specification are in line with Ofqual's GCSE subject criteria equalities review and are as follows:

	Yes/No	Type of Assessment
Readers	Yes	All assessments
Scribes	Yes	All assessments
Practical assistants	Yes	All controlled assessments. The practical assistant may assist with assessed practical tasks under instruction from the candidate.
Word processors	Yes	All assessments
Transcripts	Yes	All assessments
BSL interpreters	Yes	All assessments
Oral language modifiers	Yes	All assessments
Modified question papers	Yes	All assessments
Extra time	Yes	All assessments

7.2 Arrangements for candidates with particular requirements (including Special Consideration)

All candidates with a demonstrable need may be eligible for access arrangements to enable them to show what they know and can do. The criteria for eligibility for access arrangements can be found in the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration.*

Candidates who have been fully prepared for the assessment but who have been affected by adverse circumstances beyond their control at the time of the examination may be eligible for special consideration. As above, centres should consult the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration.*

8 Administration of GCSE Biology B

In December 2011 the GCSE qualification criteria were changed by Ofqual. As a result, all GCSE qualifications have been updated to comply with the new regulations.

The most significant change for all GCSE qualifications is that, from 2014, unitised specifications must require that 100% of the assessment is terminal.

Please note that there are no changes to the terminal rule and re-sit rules for the January 2013 and June 2013 examination series:

- at least 40% of the assessment must be taken in the examination series in which the qualification is certificated
- candidates may re-sit each unit once before certification, i.e. each candidate can have two attempts at a unit before certification.

For full information on the assessment availability and rules that apply in the January 2013 and June 2013 examination series, please refer to the previous version of this specification GCSE Biology B (March 2011) available on the website.

The sections below explain in more detail the rules that apply from the June 2014 examination series onwards.

8.1 Availability of assessment from 2014

There is one examination series available each year in June (all units are available each year in June).

GCSE Biology B certification is available in June 2014 and each June thereafter.

	Unit B731	Unit B732	Unit B733	Certification availability
June 2014	✓	✓	✓	✓
June 2015	✓	✓	✓	✓

8.2 Certification rules

For GCSE Biology B, from June 2014 onwards, a 100% terminal rule applies. Candidates must enter for all their units in the series in which the qualification is certificated.

8.3 Rules for re-taking a qualification

Candidates may enter for the qualification an unlimited number of times.

Where a candidate re-takes a qualification, **all** units must be re-entered and all externally assessed units must be re-taken in the same series as the qualification is re-certificated. The new results for these units will be used to calculate the new qualification grade. Any results previously achieved cannot be re-used.

For the controlled assessment unit, candidates who are re-taking a qualification can choose either to re-take that controlled assessment unit or to carry forward the result for that unit that was used towards the previous certification of the same qualification.

- Where a candidate decides to re-take the controlled assessment, the new result will be the one used to calculate the new qualification grade. Any results previously achieved cannot be re-used.
- Where a candidate decides to carry forward a result for controlled assessment, they must be entered for the controlled assessment unit in the re-take series using the entry code for the carry forward option (see section 8.4).

8.4 Making entries

8.4.1 Unit entries

Centres must be approved to offer OCR qualifications before they can make any entries, including estimated entries. It is recommended that centres apply to OCR to become an approved centre well in advance of making their first entries. Centres must have made an entry for a unit in order for OCR to supply the appropriate forms and administrative materials.

It is essential that correct unit entry codes are used when making unit entries.

For the externally assessed units B731 and B732 candidates must be entered for either component 01 (Foundation Tier) or 02 (Higher Tier) using the appropriate unit entry code from the table below. It is not possible for a candidate to take both components for a particular unit within the same series; however, different units may be taken at different tiers.

For the controlled assessment unit, centres can decide whether they want to submit candidates' work for moderation through the OCR Repository or by post. Candidates submitting controlled assessment must be entered for the appropriate unit entry code from the table below. Candidates who are re-taking the qualification and who want to carry forward the controlled assessment should be entered using the unit entry code for the carry forward option.

Centres should note that controlled assessment tasks can still be completed at a time which is appropriate to the centre/candidate. However, where tasks change from year to year, centres would have to ensure that candidates had completed the correct task(s) for the year of entry.

Unit entry code	Component code	Assessment method	Unit titles
B731F	01	Written Paper	*Biology modules B1, B2, B3* (Foundation Tier)
B731H	02	Written Paper	*Biology modules B1, B2, B3* (Higher Tier)
B732F	01	Written Paper	*Biology modules B4, B5, B6* (Foundation Tier)
B732H	02	Written Paper	*Biology modules B4, B5, B6* (Higher Tier)
B733A	01	Moderated via OCR Repository	*Biology controlled assessment*
B733B	02	Moderated via postal moderation	*Biology controlled assessment*
B733C	80	Carried forward	*Biology controlled assessment*

8.4.2 Certification entries

Candidates must be entered for qualification certification separately from unit assessment(s). If a certification entry is **not** made, no overall grade can be awarded.

Centres must enter candidates for:

- GCSE Biology B certification code J263.

8.5 Enquiries about results

Under certain circumstances, a centre may wish to query the result issued to one or more candidates. Enquiries about results for GCSE units must be made immediately following the series in which the relevant unit was taken and by the relevant enquiries about results deadline for that series.

Please refer to the JCQ *Post-Results Services* booklet and the OCR *Admin Guide: 14–19 Qualifications* for further guidance on enquiries about results and deadlines. Copies of the latest versions of these documents can be obtained from the OCR website.

8.6 Prohibited qualifications and classification code

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 1010.

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

Centres may wish to advise candidates that, if they take two specifications with the same classification code, colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if candidates take two GCSE specifications that have different classification codes but have significant overlap of content. Candidates who have any doubts about their subject combinations should seek advice, either from their centre or from the institution to which they wish to progress.

Other information about GCSE Biology B

9

9.1 Overlap with other qualifications

This specification has been developed alongside GCSE Science B, GCSE Additional Science B, GCSE Chemistry B, GCSE Physics B and GCSE Additional Applied Science.

Modules 1 and 2 of this specification are also included in GCSE Science B. Modules 3 and 4 of this specification are also included in GCSE Additional Science B.

Aspects of the controlled assessment of skills are common across GCSE Additional Science B, GCSE Biology B, GCSE Chemistry B and GCSE Physics B.

9.2 Progression from this qualification

GCSE qualifications are general qualifications which enable candidates to progress either directly to employment, or to proceed to further qualifications.

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Broadly, candidates who are awarded mainly Grades D to G at GCSE could either strengthen their base through further study of qualifications at Level 1 within the National Qualifications Framework or could proceed to Level 2. Candidates who are awarded mainly Grades A* to C at GCSE would be well prepared for study at Level 3 within the National Qualifications Framework.

9.3 Avoidance of bias

OCR has taken great care in preparation of this specification and assessment materials to avoid bias of any kind. Special focus is given to the 9 strands of the Equality Act with the aim of ensuring both direct and indirect discrimination is avoided.

9.4 Regulatory Requirements

This specification complies in all respects with the current: *General Conditions of Recognition; GCSE, GCE, Principal Learning and Project Code of Practice; GCSE Controlled Assessment regulations* and the *GCSE subject criteria for Biology.* All documents are available on the Ofqual website.

9.5 Language

This specification and associated assessment materials are in English only. Only answers written in English will be assessed.

9.6 Spiritual, moral, ethical, social, legislative, economic and cultural issues

This specification offers opportunities which can contribute to an understanding of these issues.

The table below gives some examples which could be used when teaching the course:

Issue	Opportunities for developing an understanding of the issue during the course
Moral issues The commitment of scientists to publish their findings and subject their ideas to testing by others.	B1c: Discuss the benefits and risks (possible side effects) associated with immunisation. B2f: Explain how Lamarck's idea of evolution by the inheritance of acquired characteristics was different from Darwin's theory.
Ethical issues The ethical implications of selected scientific issues.	B1h: Discuss the issues raised by knowledge of inherited disorders in a family.
Economic issues The range of factors which have to be considered when weighing the costs and benefits of scientific activity.	B4h: Explain that intensive farming means trying to produce as much food as possible from the land, plants and animals available.
Cultural issues Scientific explanations which give insight into the local and global environment.	B2h: Recognise that sustainability requires planning and co-operation at local, national and international levels.

9.7 Sustainable development, health and safety considerations and European developments, consistent with international agreements

This specification supports these issues, consistent with current EU agreements, as outlined below.

- Sustainable development issues could be supported through questions set on maintaining biodiversity, recycling and farming sustainably, for example.
- Health and safety considerations will be supported through the controlled assessment which will include risk assessment of planned practical work and carrying out practical work safely. Health and safety considerations could be supported through questions set on maintaining health of both individuals and societies, for example.
- European developments could be supported through study of the effects of increasing human populations, for example.

9.8 Key Skills

This specification provides opportunities for the development of the Key Skills of *Communication, Application of Number, Information and Communication Technology, Working with Others, Improving Own Learning and Performance* and *Problem Solving* at Levels 1 and/or 2. However, the extent to which this evidence fulfils the Key Skills criteria at these levels will be totally dependent on the style of teaching and learning adopted for each unit.

The following table indicates where opportunities may exist for at least some coverage of the various Key Skills criteria at Levels 1 and/or 2 for each unit.

Unit	C		AoN		ICT		WwO		IOLP		PS	
	1	2	1	2	1	2	1	2	1	2	1	2
B731	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B732	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B733	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

9.9 ICT

In order to play a full part in modern society, candidates need to be confident and effective users of ICT. This specification provides candidates with a wide range of appropriate opportunities to use ICT in order to further their study of Science.

Opportunities for ICT include:

- using video clips to show/provide the context for topics studied and to illustrate the practical importance of the scientific ideas
- gathering information from the internet and CD-ROMs
- gathering data using sensors linked to data-loggers or directly to computers
- using spreadsheets and other software to process data
- using animations and simulations to visualise scientific ideas
- using modelling software to explore theories
- using software to present ideas and information on paper and on screen.

Particular opportunities for the use of ICT appear in the introductions to each item where appropriate.

9.10 Citizenship

From September 2002, the National Curriculum for England at Key Stage 4 includes a mandatory programme of study for Citizenship.

GCSE Science is designed as a science education for future citizens which not only covers aspects of the Citizenship programme of study but also extends beyond that programme by dealing with important aspects of science which all people encounter in their everyday lives.

A Appendix A: Guidance for the production of electronic controlled assessment

Structure for evidence

A controlled assessment portfolio is a collection of folders and files containing the candidate's evidence. Folders should be organised in a structured way so that the evidence can be accessed easily by a teacher or moderator. This structure is commonly known as a folder tree. It would be helpful if the location of particular evidence is made clear by naming each file and folder appropriately and by use of an index called 'Home Page'.

There should be a top level folder detailing the candidate's centre number, candidate number, surname and forename, together with the unit code B733, so that the portfolio is clearly identified as the work of one candidate.

Each candidate produces an assignment for controlled assessment. The evidence should be contained within a separate folder within the portfolio. This folder may contain separate files.

Each candidate's controlled assessment portfolio should be stored in a secure area on the centre's network. Prior to submitting the controlled assessment portfolio to OCR, the centre should add a folder to the folder tree containing controlled assessment and summary forms.

Data formats for evidence

In order to minimise software and hardware compatibility issues it will be necessary to save candidates' work using an appropriate file format.

Candidates must use formats appropriate to the evidence that they are providing and appropriate to viewing for assessment and moderation. Open file formats or proprietary formats for which a downloadable reader or player is available are acceptable. Where this is not available, the file format is not acceptable.

Electronic controlled assessment is designed to give candidates an opportunity to demonstrate what they know, understand and can do using current technology. Candidates do not gain marks for using more sophisticated formats or for using a range of formats. A candidate who chooses to use only word documents will not be disadvantaged by that choice.

Evidence submitted is likely to be in the form of word processed documents, PowerPoint presentations, digital photos and digital video.

To ensure compatibility, all files submitted must be in the formats listed below. Where new formats become available that might be acceptable, OCR will provide further guidance. OCR advises against changing the file format that the document was originally created in. It is the centre's responsibility to ensure that the electronic portfolios submitted for moderation are accessible to the moderator and fully represent the evidence available for each candidate.

Accepted file formats

A

Movie formats for digital video evidence
MPEG (*.mpg)
QuickTime movie (*.mov)
Macromedia Shockwave (*.aam)
Macromedia Shockwave (*.dcr)
Flash (*.swf)
Windows Media File (*.wmf)
MPEG Video Layer 4 (*.mp4)

Audio or sound formats
MPEG Audio Layer 3 (*.mp3)

Graphics formats including photographic evidence
JPEG (*.jpg)
Graphics file (*.pcx)
MS bitmap (*.bmp)
GIF images (*.gif)

Animation formats
Macromedia Flash (*.fla)

Structured markup formats
XML (*.xml)

Text formats
Comma Separated Values (.csv)
PDF (.pdf)
Rich text format (.rtf)
Text document (.txt)

Microsoft Office suite
PowerPoint (.ppt)
Word (.doc)
Excel (.xls)
Visio (.vsd)
Project (.mpp)

B Appendix B: Mathematics skills for GCSE science qualifications

Candidates are permitted to use calculators in all assessments.

Candidates should be able to:

- understand number size and scale and the quantitative relationship between units
- understand when and how to use estimation
- carry out calculations involving +, – , ×, ÷, either singly or in combination, decimals, fractions, percentages and positive whole number powers
- provide answers to calculations to an appropriate number of significant figures
- understand and use the symbols =, <, >, ~
- understand and use direct proportion and simple ratios
- calculate arithmetic means
- understand and use common measures and simple compound measures such as speed
- plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms) selecting appropriate scales for the axes
- substitute numerical values into simple formulae and equations using appropriate units
- translate information between graphical and numeric form
- extract and interpret information from charts, graphs and tables
- understand the idea of probability
- calculate area, perimeters and volumes of simple shapes.

In addition, Higher Tier candidates should be able to:

- interpret, order and calculate with numbers written in standard form
- carry out calculations involving negative powers (only –1 for rate)
- change the subject of an equation
- understand and use inverse proportion
- understand and use percentiles and deciles.

Appendix C: Physical quantities and units

C

It is expected that candidates will show an understanding of the physical quantities and corresponding SI units listed below and will be able to use them in quantitative work and calculations. Whenever they are required for such questions, units will be provided and, where necessary, explained.

Fundamental physical quantities	
Physical quantity	Unit(s)
length	metre (m); kilometre (km); centimetre (cm); millimetre (mm)
mass	kilogram (kg); gram (g); milligram (mg)
time	second (s); millisecond (ms)
temperature	degree Celsius (°C); kelvin (K)
current	ampere (A); milliampere (mA)
voltage	volt (V); millivolt (mV)

Derived quantities and units	
Physical quantity	Unit(s)
area	cm^2; m^2
volume	cm^3; dm^3; m^3; litre (l); millilitre (ml)
density	kg/m^3; g/cm^3
force	newton (N)
speed	m/s; km/h
energy	joule (J); kilojoule (kJ); megajoule (MJ)
power	watt (W); kilowatt (kW); megawatt (MW)
frequency	hertz (Hz); kilohertz (kHz)
gravitational field strength	N/kg
radioactivity	becquerel (Bq)
acceleration	m/s^2; km/h^2
specific heat capacity	J/kg°C; J/g°C
specific latent heat	J/kg

D Appendix D: Health and safety

In UK law, health and safety is the responsibility of the employer. For most establishments entering candidates for GCSE, this is likely to be the local education authority or the governing body. Employees, i.e. teachers and lecturers, have a duty to cooperate with their employer on health and safety matters. Various regulations, but especially the COSHH Regulations 2002 and the Management of Health and Safety at Work Regulations 1999, require that before any activity involving a hazardous procedure or harmful micro-organisms is carried out, or hazardous chemicals are used or made, the employer must provide a risk assessment.

For members, the CLEAPSS® guide, *Managing Risk Assessment in Science** offers detailed advice. Most education employers have adopted a range of nationally available publications as the basis for their Model Risk Assessments. Those commonly used include:

Safety in Science Education, DfEE, 1996, HMSO, ISBN 0 11 270915 X

Topics in Safety, 3rd edition, 2001, ASE ISBN 0 86357 316 9

Safeguards in the School Laboratory, 11th edition, 2006, ASE ISBN 978 0 86357 408 5

CLEAPSS® *Hazcards*, 2007 edition and later updates*

CLEAPSS® *Laboratory Handbook**

Hazardous Chemicals, A Manual for Science Education, 1997, SSERC Limited ISBN 0 9531776 0 2

Where an employer has adopted these or other publications as the basis of their model risk assessments, an individual school or college then has to review them, to see if there is a need to modify or adapt them in some way to suit the particular conditions of the establishment.

Such adaptations might include a reduced scale of working, deciding that the fume cupboard provision was inadequate or the skills of the candidates were insufficient to attempt particular activities safely. The significant findings of such risk assessment should then be recorded, for example on schemes of work, published teachers guides, work sheets, etc. There is no specific legal requirement that detailed risk assessment forms should be completed, although a few employers require this.

Where project work or individual investigations, sometimes linked to work-related activities, are included in specifications this may well lead to the use of novel procedures, chemicals or micro-organisms, which are not covered by the employer's model risk assessments. The employer should have given guidance on how to proceed in such cases. Often, for members, it will involve contacting CLEAPSS® (or, in Scotland, SSERC).

*These, and other CLEAPSS® publications, are on the CLEAPSS® Science Publications CD-ROM issued annually to members. Note that CLEAPSS® publications are only available to members. For more information about CLEAPSS® go to www.cleapss.org.uk. In Scotland, SSERC www.sserc.org.uk has a similar role to CLEAPSS® and there are some reciprocal arrangements.

YOUR CHECKLIST

OUR AIM IS TO PROVIDE YOU WITH ALL THE INFORMATION AND SUPPORT YOU NEED TO DELIVER OUR SPECIFICATIONS.

- ☑ Bookmark **www.ocr.org.uk/gcse2012**
- ☑ Be among the first to hear about support materials and resources as they become available. Register for email updates at **www.ocr.org.uk/updates**
- ☑ Find out about our training courses at **www.ocreventbooker.org.uk**
- ☑ Find out about controlled assessment support at **www.ocr.org.uk/gcse2012**
- ☑ Learn more about Active Results at **www.ocr.org.uk/activeresults**
- ☑ Join our social network community for teachers at **www.social.ocr.org.uk**

NEED MORE HELP?

Here's how to contact us for specialist advice

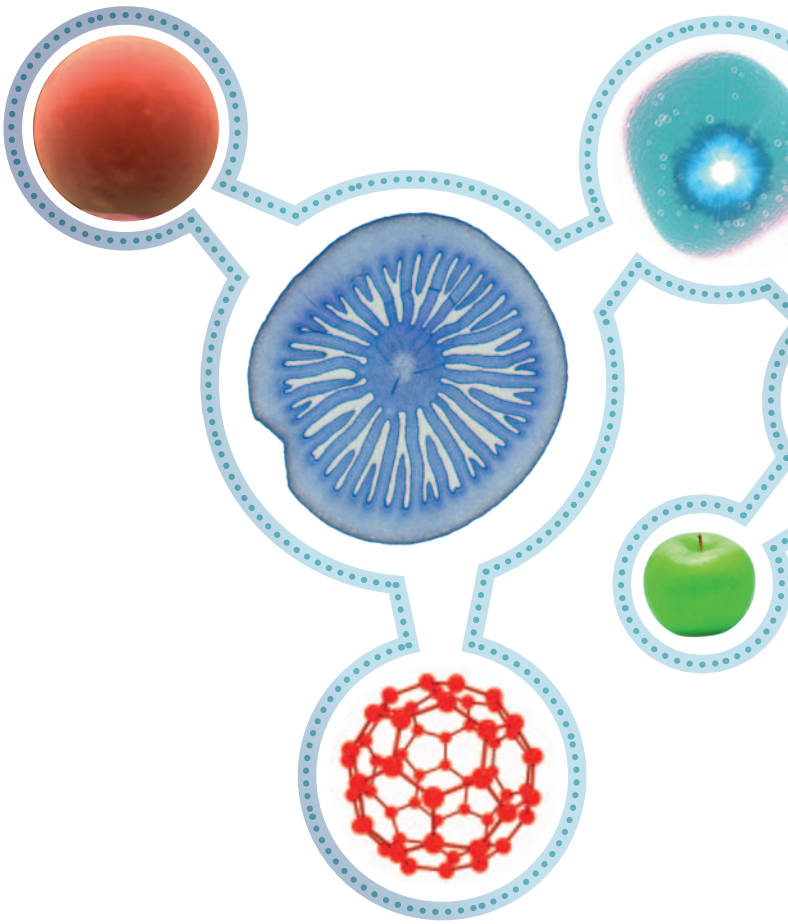
By phone: 01223 553998

By email: science@ocr.org.uk

By online: http://answers.ocr.org.uk

By fax: 01223 552627

By post: Customer Contact Centre, OCR,
Progress House, Westwood Business Park,
Coventry CV4 8JQ



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