GCSE

Rewarding Learning

CCEA GCSE Specification in

Biology

For first teaching from September 2017
For first assessment in Summer 2018
For first award in Summer 2019
Subject Code: 1010

Contents

Subject Code	1010
QAN	603/1371/7

This specification is available online at www.ccea.org.uk

1 Introduction

This specification sets out the content and assessment details for our GCSE course in Biology. We have designed this specification to meet the requirements of:

- Northern Ireland GCSE Design Principles; and
- Northern Ireland GCE and GCSE Qualifications Criteria.

First teaching is from September 2017. We will make the first award based on this specification in Summer 2019.

This specification is a unitised course. The guided learning hours, as for all our GCSEs, are 120 hours.

The specification supports the aim of the Northern Ireland Curriculum to empower young people to achieve their potential and to make informed and responsible decisions throughout their lives, as well is its objectives:

- to develop the young person as an individual;
- to develop the young person as a contributor to society; and
- to develop the young person as a contributor to the economy and environment.

If there are any major changes to this specification, we will notify centres in writing. The online version of the specification will always be the most up to date; to view and download this please go to www.ccea.org.uk

1.1 Aims

This CCEA course in GCSE Biology provides a broad, coherent and practical course that develops confidence in and a positive view of science. It encourages students to appreciate the value of science in their lives and in the wider world around them.

This specification aims to encourage students 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; and
- develop their skills in communication, mathematics and the use of technology in scientific contexts.

1.2 Key features

The following are important features of this specification.

- It offers opportunities to build on the skills and capabilities developed through the delivery of the Northern Ireland Curriculum at Key Stage 3.
- The GCSE Biology specification is divided into three units.
- Units 1 and 2 each contain prescribed practicals in the specification; students carry out nine practicals over the two years of this course.
- Students carry out these investigations to develop their skills and knowledge of practical science.
- Units 1 and 2 are each assessed by a written examination either at Foundation Tier (grades C*–G) or Higher tier (grades A*–D/E).
- Unit 3 is an externally assessed Practical Skills unit in two parts: Booklet A and Booklet B, at either Foundation Tier (grades C*–G) or Higher Tier (grades A*–D/E).
- Booklet A has two practicals from the prescribed practical list. We send a Materials and Apparatus list in December. We send a copy of Booklet A for each student to schools in January. All students must carry these out by May. They are marked externally.

- Booklet B is a timetabled, externally assessed exam taken at the end of final year of study. It consists of questions about planning and carrying out any of the prescribed practicals as well as more general questions about any practical situation that arises from the specification.
- From Summer 2019, students may take Unit 1 or Unit 2 at the end of their first year of study. (Please note that in Summer 2018 only Unit 1 is available.)
- Students can resit each unit once.
- It provides a thorough preparation for the study of biology and related courses at GCE Advanced Subsidiary Level and Advanced Level. It also allows students to develop transferable skills that will benefit them in vocational training and employment.
- It gives students the opportunity to develop the ability to apply skills to real-life contexts.
- A range of support is available for both teachers and students, including specimen papers, mark schemes and planning frameworks. You can download these from our website at www.ccea.org.uk

1.3 Prior attainment

Students do not need to have reached a particular level of attainment before beginning to study this specification.

The specification builds on the knowledge, skills and understanding developed through the Northern Ireland Curriculum for science at Key Stage 3.

1.4 Classification codes and subject combinations

Every specification has a national classification code that indicates its subject area. The classification code for this qualification is 1010.

Please note that if a student takes two qualifications with the same classification code, schools, colleges and universities that they apply to may take the view that they have achieved only one of the two GSCEs. The same may occur with any two GCSE qualifications that have a significant overlap in content, even if the classification codes are different. Because of this, students who have any doubts about their subject combinations should check with the schools, colleges and universities that they would like to attend before beginning their studies.

2 Specification at a Glance

The table below summarises the structure of this GCSE course.

Content	Assessment	Weightings	Availability
Unit 1: **Cells, Living Processes and Biodiversity**	External written examination Students answer compulsory structured questions that include short responses, extended writing and calculations. Foundation and Higher Tiers: 1 hour 15 mins	35%	Summer from 2018
Unit 2: **Body Systems, Genetics, Microorganisms and Health**	Externally written examination Students answer compulsory structured questions that require short responses, extended writing and calculations. Foundation and Higher Tiers: 1 hour 30 mins	40%	Summer from 2019
Unit 3: **Practical skills**	**Booklet A** Students carry out two externally marked pre-release practicals in the final year of study. Foundation and Higher Tiers: 2 hours	7.5%	Between 1 January and 1 May each year (beginning in 2019)

Content	Assessment	Weightings	Availability
	Booklet B External written examination Students answer compulsory structured questions that include short responses, extended writing and calculations, all set in a practical context. There are two tiers of entry Foundation and Higher Tiers: 1 hour	17.5%	Every Summer (beginning in 2019)

Students must take at least 40% of the assessment (based on unit weightings) at the end of the course as terminal assessment.

3 Subject Content

We have divided this course into three units. The content of each unit and the respective learning outcomes appear below.

Content for the **Higher Tier only** is in **bold**.
Questions in Higher Tier papers may be set on any content in the specification.

Content for the Foundation Tier is in normal type.
Questions in Foundation Tier papers will only be set on this content.

The prescribed practicals are shown in *italics*.

3.1 Unit 1: Cells, Living Processes and Biodiversity

In this unit, students learn about cells, photosynthesis, nutrition and health, enzymes, breathing and respiration, the nervous system and hormones, and ecological relationships. Students begin by investigating the cell and its importance as the fundamental building block of life, and develop their understanding of the key processes that occur in plants and animals. Finally, they carry out fieldwork in a natural ecosystem to observe living specimens and explore how organisms are adapted to their environment.

Content	Learning Outcomes
1.1 **Cells** **Microscopy**	Students should be able to: • *make a temporary slide and use a light microscope to examine, draw and identify the structures of a typical plant and animal cell and produce labelled biological drawings (Practical 1.1);*
	1.1.1 explain how greater resolution of electron microscopes has increased our understanding of cell structures; and
Size and magnification	1.1.2 determine the size of biological specimens by: • estimation; • measurement in SI units (metre, millimetre, micrometre); • calculation using the equation: magnification = size of image ÷ size of real object • **using a scale bar**.

Content	Learning Outcomes
Animal cells **Plant cells** **Bacterial cells** **Stem cells**	Students should be able to: 1.1.3 demonstrate knowledge of the structure and function of animal cells, including nucleus and chromosomes, cytoplasm, **mitochondria as the site of cell respiration**, and cell and nuclear membranes; 1.1.4 demonstrate knowledge that plant cells can have additional structures not found in animal cells: cellulose cell wall, large permanent vacuole and chloroplasts; 1.1.5 compare and contrast the structure of bacterial cells with plant and animal cells: non-cellulose cell wall, absence of nucleus and presence of plasmids; 1.1.6 demonstrate knowledge and understanding that a stem cell is a simple cell in animals and plants that has the ability to divide to form cells of the same type: • in animals stem cells can be harvested from the (embryonic) umbilical cord or bone marrow (adult); • embryonic stem cells form a full range of cell types while adult stem cells form a limited range of cell types; • most animal stem cells change permanently at an early stage into specialised cells with structures that adapt them to a particular function; and • in plants, stem cells originate from meristems at the apices of roots and stems and many of these cells retain the ability to divide and so can be used in cloning techniques; **and** **1.1.7 demonstrate knowledge and understanding that using stem cells in medicine has:** • **potential benefits, including bone marrow transplants in treating leukaemia;** • **potential risks with ethical implications, including pre-treatment using radiotherapy or chemotherapy, transfer of viruses or diseases from other animals, formation of tumours or development of unwanted cell types; and** • **the validation of research by peer review.**

Content	Learning Outcomes
Specialisation	Students should be able to: 1.1.8 demonstrate knowledge and understanding that multicelled organisms' cells can form specialised tissues, organs and organ systems; 1.1.9 **explain the need for exchange surfaces and a transport system in multicelled organisms in terms of surface area : volume ratio**;
Diffusion	1.1.10 describe and explain the process of diffusion, which transports substances, including oxygen, carbon dioxide, water, dissolved nutrient molecules and mineral ions, into and out of cells and organisms: • as the movement of molecules from a region of high concentration to a region of low concentration; and • the rate of diffusion is affected by temperature, surface area and concentration gradient; 1.1.11 investigate the effect of surface area on the rate of diffusion;
1.2 Photosynthesis and plants **Photosynthesis Equations**	1.2.1 demonstrate knowledge and understanding of photosynthesis as an endothermic process that takes place in chloroplasts, where chlorophyll absorbs light energy and produces sugars and starch; and 1.2.2 recall the word equation for photosynthesis: carbon dioxide + water $\xrightarrow[\text{(chlorophyll)}]{\text{light}}$ glucose + oxygen **and the balanced chemical equation:** $\mathbf{6CO_2 + 6H_2O \xrightarrow[(chlorophyll)]{light} C_6H_{12}O_6 + 6O_2}$

Content	Learning Outcomes
Investigating photosynthesis	Students should be able to: 1.2.3 explain investigations into how photosynthesis requires light, carbon dioxide and chlorophyll to show that biology is an evidence-based discipline, including: • how and why a plant is destarched; • testing a leaf for starch by boiling in water, boiling in ethanol, softening in water and testing with iodine solution; • the production of oxygen; • using sodium hydroxide to absorb carbon dioxide; and • using a variegated leaf to illustrate the role of chlorophyll; • *investigate the need for light and chlorophyll in photosynthesis by testing a leaf for starch (Practical 1.2);*
Limiting factors	1.2.4 explain how temperature, light intensity and carbon dioxide concentration affect the rate of photosynthesis **and interpret data on how limiting factors affect the rate of photosynthesis; and**
Gas exchange	1.2.5 **explain how the relationship between photosynthesis and respiration affects the gas exchange between organisms and their environment, including:** • **demonstrating knowledge of the colour changes of hydrogencarbonate indicator (high CO_2 – yellow, normal (0.03%) CO_2 – red and low CO_2 – purple); and** • **demonstrating compensation point**.

<table>
<tr><th>Content</th><th>Learning Outcomes</th></tr>
<tr><td>Leaf structure

1.3
Nutrition and food tests</td><td>Students should be able to:

1.2.6 describe the structure and shape of the mesophytic leaf and identify its adaptations for gas exchange and light absorption, including:
• the epidermis, with cell walls as a physical defence that are transparent to allow light through;
• the waxy cuticle, which is a physical defence that is transparent to allow light through and waterproof to reduce water loss;
• the palisade mesophyll cells, which are tightly packed, end on to the upper surface with many chloroplasts to increase photosynthesis;
• the spongy mesophyll cells, with a few chloroplasts and a large surface area for gas exchange;
• intercellular spaces, which allow diffusion of gases through the leaf; and
• guard cells and stomata, which allow gases to diffuse into and out of the leaf;

1.3.1 recall the following reagents and their colour changes:
<table><tr><th>Reagent</th><th>Initial colour</th><th>End colour for positive result</th></tr><tr><td>Benedict’s</td><td>Blue</td><td>Brick red precipitate</td></tr><tr><td>Iodine solution</td><td>Yellow–brown</td><td>Blue–black</td></tr><tr><td>Biuret</td><td>Blue</td><td>Lilac/Purple</td></tr><tr><td>Ethanol</td><td>Colourless</td><td>White emulsion</td></tr></table>
1.3.2 investigate food samples using food tests, including:
• reducing sugar (Benedict’s);
• starch (iodine solution);
• amino acid or protein (Biuret); and
• fats (ethanol).</td></tr>
</table>

Content	Learning Outcomes
Biological molecules	Students should be able to: 1.3.3 explain the importance of the following biological molecules: • carbohydrates, made up of simple carbohydrates (sugars, glucose and lactose) as sources of energy and storage, complex carbohydrates (cellulose, starch and glycogen); • fats/**lipids,** including oils, made up of fatty acids and glycerol, as sources of energy and storage; and • proteins, made up of amino acids, as structural and functional molecules in cells;
Food and energy	• *investigate the energy content of food by burning food samples(Practical 1.3);*
1.4 Enzymes and digestion	1.4.1 describe the actions of enzymes as proteins that are biological catalysts that speed up the rate of reactions without being used up, to include carbohydrase (amylase), lipase and protease, and interpret the results using the lock and key model to illustrate substrate specificity; 1.4.2 interpret how temperature, pH, enzyme concentration **and inhibitors** affect the action of enzymes, including: • low temperature causing reduced rates of collision between substrate and enzyme; • describing the maximum rate of reaction as the optimum; • denaturation occurring increasingly at levels above the optimum, explained as an irreversible change to the shape of the active site that inhibits enzyme action; **and** • **inhibitors as molecules that fit the active site but are not broken down (no further detail required)**; and • *investigate the effect of temperature on the action of an enzyme (Practical 1.4)*.

Content	Learning Outcomes
Enzymes and digestion (cont.)	Students should be able to:
	1.4.3 demonstrate knowledge and understanding that in food digestion, enzymes are needed to break down (digest) large, insoluble molecules into small, soluble ones that can then be absorbed into the bloodstream and that they have commercial and economic uses, including biological washing powders;
The digestive system	1.4.4 relate the structure of the ileum to its function of absorbing digested nutrient molecules and how it is adapted: large surface area (length, folds and villi), good blood supply, and thin and permeable membranes;
	1.4.5 **explain how the structure of a villus (finger-like shape, single layer of surface cells, capillary network and lacteal) is adapted to absorb digested food molecules efficiently**;
1.5 The respiratory system, breathing and respiration	1.5.1 describe the structures of the respiratory system and relate them to their functions, including the nasal cavity, trachea, bronchus, bronchioles, lungs, alveoli, diaphragm, ribs, intercostal muscles, pleural membranes **and pleural fluid**;
Respiratory surfaces	1.5.2 explain the adaptations of respiratory surfaces in plants and animals, including large surface area, thin, moist, permeable, good blood supply and diffusion gradient;
Lung model	1.5.3 use a lung model to describe and explain breathing as changes in pressure and volume of the thoracic cavity that result from the actions of the diaphragm, ribs and intercostal muscles;
	1.5.4 demonstrate knowledge and understanding of the effect of exercise on the depth and rate of breathing; and
Respiration	1.5.5 demonstrate knowledge and understanding that respiration is a reaction **that is exothermic, taking place in mitochondria,** continuously releasing energy in all cells that organisms can use for heat, movement, growth, reproduction **and active uptake/transport**.

Content	Learning Outcomes
Equation for respiration	Students should be able to: 1.5.6 recall the word equation for aerobic respiration glucose + oxygen → energy + carbon dioxide + water **and the balanced chemical equation** **$C_6H_{12}O_6 + 6O_2 \rightarrow$ energy + $6CO_2 + 6H_2O$**
Aerobic and anaerobic respiration	1.5.7 compare and contrast aerobic respiration with anaerobic respiration in mammalian muscle glucose → energy + lactic acid and in yeast glucose → energy + alcohol + carbon dioxide • *investigate factors affecting the respiration of yeast (Practical 1.5);*
1.6 Nervous system and hormones	1.6.1 compare and contrast the two communication systems (nervous and hormonal) in the human body, including the speed and nature of the response; and
Central nervous system	1.6.2 describe and explain the basic structure and function of the central nervous system: the brain and spinal cord together form the central nervous system that controls and co-ordinates the responses between the receptors and effectors, and muscles.

Content	Learning Outcomes
The eye	Students should be able to: 1.6.3 use models and specimens to identify the following component parts of the eye and understand their functions in producing a focused image on the retina under different light conditions: • conjunctiva helps prevent microorganisms entering the eye; • cornea allows light into the eye and causes it to bend (refract) slightly; • pupil allows light into the eye; • iris controls the amount of light entering the eye by changing its diameter; • lens bends (refracts) the light towards the retina; • aqueous and vitreous humour help maintain the shape of the eye and lens; • retina contains cells that are sensitive to different types of light; and • optic nerve transfers nerve impulses from the light-sensitive cells of the retina to the brain; 1.6.4 **extend their knowledge and understanding of the eye, including how the ciliary muscles and suspensory ligaments change the shape of the lens so that near and distant objects may focus on the retina (accommodation);**
Neurones and synapses	1.6.5 demonstrate knowledge and understanding how neurones are adapted to their function by their cell body, branched ends, long axon length and insulating myelin sheath; **and** 1.6.6 **demonstrate knowledge and understanding of synapses as gaps between neurones that:** • **function as junctions; and** • **allow the nerve impulse to pass due to diffusion of a transmitter chemical produced by the end of the neurone leading into the synapse, which in high enough concentration triggers an impulse in the next neurone.**

Content	Learning Outcomes
Voluntary and reflex actions	Students should be able to: 1.6.7 distinguish between voluntary and reflex actions, referring to conscious control and speed of response;
Reflex arc	1.6.8 **demonstrate knowledge and understanding of the pathway of the spinal reflex arc, including:** • **a receptor that detects stimuli in the environment and produces nerve impulses;** • **a sensory, an association and a motor neurone connected by synapses (gaps between neurones); and** • **an effector (a muscle or gland) that responds to impulses from the motor neurone;**
Homeostasis	1.6.9 explain the importance of maintaining a constant internal environment for the proper functioning of cells and enzymes in response to internal and external change, limited to controlling blood glucose concentration and osmoregulation; and
Hormones	1.6.10 demonstrate knowledge and understanding that hormones are chemical messengers produced by glands and released into the blood, which carries them to a target organ where they act, referring to: • the pancreas constantly monitoring blood glucose concentration; • the pancreas producing insulin in response to increasing blood glucose concentration; • insulin acting by causing the liver and muscles to absorb more glucose from the blood, so lowering blood glucose concentration; and • liver cells either respiring the absorbed glucose or converting it to glycogen, which they store.

Content	Learning Outcomes
Diabetes	Students should be able to: 1.6.11 **explain negative feedback exemplified by the role of insulin in the control of blood glucose**; 1.6.12 demonstrate knowledge and understanding that: • diabetes is a condition in which the blood glucose control mechanism fails; • Type 1 diabetes usually occurs early in life when the pancreas stops producing insulin, which then has to be taken as medication throughout life; • Type 2 diabetes is a progressive disease linked to lifestyle factors and obesity, when the pancreas gradually produces less insulin, which in early stages means it can be controlled by diet but later may also require insulin injections; • the symptoms of diabetes include high blood glucose, glucose in the urine, lethargy and thirst; • possible long-term effects of diabetes include eye damage, kidney failure, heart disease and strokes; and • the number of people with diabetes in the population is rising and evaluate why;
Excretory system	1.6.13 describe the gross structure of the excretory system, including the kidney (renal artery, renal vein, cortex, medulla and pelvis only, no detail of the nephron needed), ureters, bladder and urethra;
Osmoregulation	1.6.14 demonstrate knowledge and understanding of the kidney's homeostatic role in maintaining water balance in the body (osmoregulation) limited to: • water gained through intake in food and drink and the production of water by respiration; • water lost through evaporation of sweat, evaporation during breathing and the production of urine by the kidney; and • the role of the kidney in filtering the blood and controlling the reabsorption of water; **and** 1.6.15 **explain the role of antidiuretic hormone (ADH) as a hormone that causes the kidney to reabsorb more water and so reduce the volume of urine production (negative feedback not required)**.

Content	Learning Outcomes
Plant hormones	Students should be able to: 1.6.16 explain how plant hormones are important in controlling and co-ordinating plant growth and development, referring to phototropism in stems as a differential growth of cells caused by uneven distribution of the hormone auxin in response to unidirectional light; 1.6.17 **extend their knowledge and understanding of phototropism including:** • **auxin produced at the tip of the shoot;** • **auxin moving down the shoot;** • **light causing uneven distribution of auxin; and** • **auxin causing cell elongation, which results in bending of the shoot**;
1.7 Ecological relationships and energy flow	1.7.1 demonstrate knowledge and understanding of the terms biodiversity, population, habitat, environment, community and ecosystem;
Fieldwork	1.7.2 measure biotic and abiotic factors such as wind speed, water, pH, light, temperature and biodiversity (the number of plant and animal species) and explain how they affect communities; 1.7.3 describe how to use quadrats to investigate changes in the distribution and population of organisms within a sample area of a habitat, limited to belt transect and random sampling; • *use quadrats to investigate the abundance of plants and/or animals in a habitat* (*Practical 1.6)*; and
Competition	1.7.4 account for the distribution of plants and animals by describing how the organisms found have adapted to their environment and the competition for resources – water, light, space and minerals in plants and water, food, territory, mates and predators in animals – that can affect population growth and how humans influence the normal balance of ecosystems.

Content	Learning Outcomes
Role of the Sun as energy source	Students should be able to: 1.7.5 demonstrate knowledge and understanding that the Sun is the source of energy for most ecosystems on Earth and the role of green plants as producers in capturing this energy and making it available to other organisms;
Food chains and food webs	1.7.6 demonstrate knowledge and understanding of food chains and webs by: • identifying producers and consumers; • describing the differences between the trophic levels; and • understanding that arrows represent consumption and the transfer of substances (carbon and nitrogen) and energy through the ecosystem;
Energy flow	1.7.7 calculate the efficiency of energy transfers between trophic levels and explain how this affects the amount of energy available at each trophic level due to heat from respiration, excretion, egestion and uneaten structures, **and understand why shorter food chains are more efficient**;
Pyramids of numbers and biomass	1.7.8 construct pyramids of numbers and biomass as models of food chains and explain the difference, **and explain the advantages and disadvantages of each type of pyramid**;
Decomposition	1.7.9 demonstrate knowledge and understanding of the decomposing action of saprophytic fungi and bacteria, including: • secretion of enzymes, extracellular digestion and absorption; • recycling nutrients through the abiotic and biotic components of the ecosystem; and • forming humus; and 1.7.10 investigate the key features of the decay process (temperature and water content) and their effect on the rate of decomposition in aerobic and anaerobic environments.

Content	Learning Outcomes
Carbon cycle	Students should be able to: 1.7.11 demonstrate knowledge and understanding of the significance of photosynthesis, respiration, combustion, fossilisation, feeding, excretion, egestion and decomposition in the carbon cycle, and how substances are constantly removed from and returned to the environment;
Global warming	1.7.12 **evaluate the evidence for how environmental changes affect the distribution of organisms, limited to increasing levels of carbon dioxide leading to global warming and demonstrate knowledge and understanding of:** • **the causes, including combustion of fossil fuels and deforestation; and** • **the problems associated with this, including:** – **increasing temperatures (melting ice caps, rising sea levels or flooding);** – **increasing frequency of extreme weather (storms or drought); and** – **loss of habitats; and**
Nitrogen cycle	1.7.13 **demonstrate knowledge and understanding of the role that microorganisms have in the nitrogen cycle, to include nitrogen fixation, nitrification, denitrification and decomposition (knowledge of the names of specific bacteria is not required) and apply this to aerobic and anaerobic conditions, for example waterlogging**.

Content	Learning Outcomes
Minerals	Students should be able to: 1.7.14 demonstrate knowledge and understanding that plants absorb minerals from the soil through root hairs by **active uptake/transport**, including: • absorption of nitrates for proteins, calcium for cell walls and magnesium for chlorophyll; • growers can add minerals to the soil in the form of natural fertilisers (farmyard manure, slurry, compost) or artificial fertilisers; • root hair cells as specialised cells that are adapted to absorbing minerals and water from the soil by having an extended shape, providing an increased surface area; and • **active uptake/transport is a process that requires energy from respiration to transport the minerals against a concentration gradient**;
Eutrophication	1.7.15 **explain how sewage disposal and fertiliser run-off can cause eutrophication, including:** • **nitrates stimulating growth of aquatic plants and algae;** • **aquatic plants and algae dying due to subsequent nitrate depletion and shading;** • **the role of aerobic microorganisms in the decomposition of plants and algae; and** • **the consequences of oxygen depletion on other aquatic vertebrates and invertebrates;** and
Human activity and biodiversity	1.7.16 demonstrate knowledge and understanding that human activity can have positive effects on biodiversity, including the role of: • reforestation and sustainable woodlands; and • international treaties in reducing global CO_2 levels.

3.2 Unit 2: Body Systems, Genetics, Microorganisms and Health

In this unit, students focus on osmosis and plant transport, the circulatory system, reproduction, fertility and contraception, genome, chromosomes, genes and DNA, cell division and genetics, variation and selection, microorganisms, defence mechanisms and cancer. Students develop their understanding of the processes involved in maintaining all life and investigate problems that arise due to genetic or environmental causes. Students also explore the issues associated with non-communicable diseases, such as heart attacks, strokes and cancer.

Content	Learning Outcomes
2.1 Osmosis and plant transport **Osmosis, plasmolysis and turgidity**	Students should be able to: • *investigate the process of osmosis by measuring the change in length or mass of plant tissue or model cells, using Visking tubing (Practical 2.1)*; 2.1.1 identify changes in plant cell structure that occur in plasmolysed and turgid cells due to osmosis (linked to 1.1.3–4); 2.1.2 explain osmosis as diffusion of water molecules from a dilute solution to a more concentrated solution, through a selectively permeable membrane; 2.1.3 explain how osmosis causes plant cells to become plasmolysed and turgid and demonstrate knowledge and understanding of the role of the cell wall in limiting the entry of water;
The potometer	• *use a potometer (bubble and weight potometer) to investigate the factors affecting the rate of water uptake by a plant and washing line method to investigate the factors affecting the rate of water loss from leaves (Practical 2.2)*;
Transpiration	2.1.4 define transpiration as evaporation from mesophyll cells followed by diffusion through airspaces and stomata (linked to 1.2.6); and 2.1.5 explain how surface area, wind, temperature, humidity and light intensity affect transpiration and the rate of water uptake by a plant (linked to 1.2.6).

Content	Learning Outcomes
Uses of water	Students should be able to: 2.1.6 demonstrate knowledge and understanding that plants use water for support, transport, transpiration and photosynthesis;
2.2 Circulatory system **Blood components**	2.2.1 use a microscope to examine a blood smear, identify the component parts and understand their function: ● red cells are a specialised cell adapted to oxygen transport – biconcave shape, absence of nucleus and haemoglobin containing iron; ● white cells are a defence against disease; ● platelets have a role in converting fibrinogen to fibrin, causing blood clotting and scab formation; and ● plasma transports cells, food molecules, carbon dioxide, hormones and urea;
Cell lysis	2.2.2 **demonstrate knowledge and understanding of the effect of placing red blood cells in water, causing cell lysis** (linked to 1.1.3, 1.6.9 and 1.6.14);
Blood vessels	2.2.3 describe the structure of blood vessels (arteries, veins and capillaries) and relate their structures to their functions, including: ● wall thickness; ● presence of muscle and elastic fibres; ● lumen diameter; and ● presence of valves; and 2.2.4 demonstrate knowledge and understanding of the role of the different types of blood vessel, including: ● arteries carrying blood under high pressure away from the heart (usually oxygenated blood); ● veins carry (usually deoxygenated) blood under low pressure towards the heart, with valves that maintain the direction of flow; and ● capillaries allowing the exchange of material with tissues through permeable walls.

Content	Learning Outcomes
Blood vessels (cont.)	Students should be able to: 2.2.5 name and demonstrate knowledge and understanding of the functions of blood vessels entering and leaving the heart, lungs, liver, kidneys (linked to 1.6.13) and intestine, describing the sequence and direction of flow in double circulation of oxygenated and deoxygenated blood;
Effects of exercise	2.2.6 investigate the effects of exercise on the pulse rate (linked to 1.5.4 and 1.5.5); 2.2.7 explain the effects of exercise on the circulatory system including: ● increased muscle contraction requiring energy from respiration (linked to 1.5.4 and 1.5.5); ● increased cardiac output and blood flow to muscles to supply glucose and oxygen; ● increased heart rate and higher blood pressure; and ● strengthened heart muscle;
The heart	2.2.8 examine the heart and relate its structures to the function of a unidirectional pump, to include identifying the four chambers, valves, thickness of muscle wall and coronary blood vessels;
2.3 Reproduction, fertility and contraception	2.3.1 demonstrate knowledge and understanding of the structure and function of the male reproductive system, including the testes, urethra, scrotum, penis, sperm tube and prostate gland; and 2.3.2 demonstrate knowledge and understanding of the structure and function of the female reproductive system, including the ovaries, oviducts, uterus, cervix and vagina.

Content	Learning Outcomes
Sperm formation and pregnancy	Students should be able to: 2.3.3 demonstrate knowledge and understanding that: • sperm cells are specialised cells (linked to 1.1.3 and 1.1.8) formed by meiosis and are adapted to their function by having a haploid nucleus**, mitochondria for energy production (linked to 1.1.3)** and a flagellum for swimming; • fertilisation takes place in the oviducts when the haploid sperm and egg nuclei fuse to give a diploid zygote; • the zygote divides by mitosis many times to form a ball of cells as it travels down the oviduct to the uterus; • after implantation in the uterus lining, the embryo then differentiates to produce a variety of tissues and organs; • the placenta is adapted for diffusion by having a large surface area for exchanging dissolved nutrients, oxygen, carbon dioxide and urea **and explain the role of villi in providing these adaptations**; • these substances are carried to or from the foetus in the blood vessels in the umbilical cord; and • the amnion and amniotic fluid cushion the foetus;
Sex hormones	2.3.4 demonstrate knowledge and understanding that testosterone, produced by the testes, and oestrogen, produced by the ovaries, are sex hormones (linked to 1.6.10) and recall the secondary sexual characteristics they cause to develop;
Menstrual cycle	2.3.5 describe the events of the menstrual cycle, including menstruation, ovulation, the time when fertilisation is most likely to occur and the roles of oestrogen and progesterone; **and**
Infertility	2.3.6 **explain some of the causes of infertility and the following developments in fertility treatment in humans:** • **the use of hormones to produce multiple ova;** • **in vitro fertilisation; and** • **the transfer of several embryos into the uterus.**

Content	Learning Outcomes
Contraception	Students should be able to: 2.3.7 examine how different methods of contraception work and evaluate the advantages and disadvantages of each, including: ● mechanical – the condom (male and female) as a barrier to prevent the passage of sperm and also prevent the spread of sexually transmitted infections (such as HIV leading to AIDS) some of which can lead to infertility if left untreated, for example chlamydia; ● chemical – the contraceptive pill and implants, which change hormone levels and stop the development of the ovum; ● surgical – male and female sterilisation to prevent the passage of sperm and ova respectively; and ● an awareness that contraception can raise ethical issues for some people;
2.4 Genome, chromosomes, DNA and genetics	2.4.1 describe the genome as the entire genetic material of an organism;
Chromosomes	2.4.2 identify and describe chromosomes as genetic structures occurring in functional pairs in the nucleus of cells, except gametes and bacteria (linked to 1.1.3 and 1.1.5); and
Genes and alleles	2.4.3 identify and describe genes and alleles as sections of chromosomes made up of short lengths of DNA that operate as functional units to control characteristics and understand that alleles are different forms of the same gene.

Content	Learning Outcomes
DNA structure	Students should be able to: 2.4.4 demonstrate knowledge and understanding of the structure of DNA, including: ● a phosphate and sugar (deoxyribose) backbone with interlinking bases to form a double helix; ● base pairing rules and the unique nature of an individual's DNA; **and** ● **the link between the DNA code and the build-up of amino acids in the correct sequence to form protein: the base triplet hypothesis (transcription and translation not required)**;
Cell division	2.4.5 demonstrate knowledge and understanding of mitosis as part of the cell cycle, limited to cell growth and cell division, which allows organisms to: ● grow; ● replace worn out cells; and ● repair damaged tissue;
Mitosis	2.4.6 outline mitosis as the exact duplication of chromosomes producing daughter cells that are genetically identical to parent cells, clones (names of phases and details of DNA replication not required); and
Meiosis	2.4.7 demonstrate knowledge and understanding of meiosis as reduction division (one cell producing four genetically different, haploid daughter cells) **and as a process that, through independent assortment, reassorts the chromosomes to provide variation (crossing over and the stages of meiosis are not required)**.

Content	Learning Outcomes
Genetic diagrams and terminology	Students should be able to: 2.4.8 demonstrate knowledge and understanding of and interpret genetic diagrams consisting of a single characteristic controlled by a single gene with two alleles (monohybrid cross) in plants, animals and humans, including: • dominant and recessive alleles; • genotype, phenotype, gamete and offspring ratios, percentages and probabilities; • homozygous and heterozygous genotypes; • Punnett squares to determine genotype frequencies; • **test (back) crosses to determine an unknown genotype; and** • **pedigree diagrams**; 2.4.9 describe the role of Mendel's monohybrid crosses in developing our understanding of genetics;
The X and Y chromosomes	2.4.10 demonstrate knowledge and understanding of how sex is determined in humans;
Genetic conditions	2.4.11 demonstrate knowledge and understanding of and explain the inheritance of these genetic conditions: • **haemophilia**; • cystic fibrosis; • Huntington's disease; and • Down's Syndrome; and
Genetic screening	2.4.12 explore the increasing understanding of the human genome and evaluate the associated ethical issues of genetic screening, including: • who decides who will be tested; • benefits and risks of amniocentesis compared to blood tests; • the dilemma for carriers of genetic conditions after a test that diagnoses abnormalities; and • making genetic information available to wider society, for example insurance companies.

Content	Learning Outcomes
Genetic engineering	Students should be able to: 2.4.13 demonstrate knowledge and understanding of genetic engineering as a process that modifies the genome of an organism to introduce desirable characteristics**, including:** ● **the basic techniques used to produce human insulin for treatment of diabetes (transfer of a human insulin gene into a plasmid of a bacterial cell to form a genetically modified bacterium that can then be cultured in a fermenter to produce human insulin);** ● **using restriction enzymes to produce 'sticky ends';** ● **the need for down streaming (extraction, purification and packaging) to produce a pure form of insulin that can be used to treat diabetes; and** ● **the advantages of producing human insulin and other products by this method**;
2.5 Variation and natural selection **Types of variation**	2.5.1 investigate variation in living things and display data using appropriate graphical techniques, including: ● height and length as examples of continuous variation (histogram); and ● tongue rolling and hand dominance as examples of discontinuous variation (bar chart); and 2.5.2 demonstrate knowledge and understanding that variation in living organisms has: ● a genetic basis – mutations (random changes in the number of chromosomes or the structure of a gene) and sexual reproduction produce different phenotypes in a population; and ● an environmental basis influencing the development of a phenotype (for example height in humans).

Content	Learning Outcomes
Natural selection	Students should be able to: 2.5.3 demonstrate knowledge and understanding of how variation and natural selection may lead to evolution or extinction, including: ● variation in the phenotypes of a population; ● competition for resources often leading to differential survival of the best adapted phenotypes, for example antibiotic resistance; ● surviving phenotypes are more likely to reproduce and pass on their genes to the next generation; ● **the theory of evolution as a continuing process of natural selection that leads to gradual changes in organisms over time, which may result in the formation of a new species;** ● **the role of fossils in providing evidence for evolution**; and ● extinction of a species over time as a consequence of failure to adapt to environmental change;
Selective breeding	2.5.4 explain selective breeding in food plants and domesticated animals as a process in which: ● humans select individual plants or animals for their desirable genetic characteristics, for example appearance, increased food quantity or quality or disease resistance, and breed them to produce offspring; and ● repeated selection and breeding over many generations causes all the offspring to show the desired characteristic;
2.6 Health, disease, defence mechanisms and treatments	2.6.1 define health as being free from communicable and non-communicable disease; and 2.6.2 explain the costs to society of communicable and non-communicable diseases, including the economic cost of treatment for the National Health Service.

Content	Learning Outcomes
Communicable diseases	Students should be able to: 2.6.3 demonstrate knowledge and understanding of the types of communicable diseases caused by microorganisms, how they are spread, prevented and treated, including: ● bacteria (chlamydia, salmonella and tuberculosis); ● viruses (HIV leading to AIDS, cold and flu and human papilloma virus (HPV)); and ● fungi (athlete's foot and potato blight);
Aseptic techniques	2.6.4 safely use aseptic techniques to grow uncontaminated colonies of bacteria in nutrient broth or on an agar plate, including: ● sterilising Petri dishes, culture media, inoculating loops and culture bottles by autoclaving, flaming and alcohol to kill unwanted microorganisms; ● needing to keep Petri dishes partially covered and to work near a Bunsen burner during inoculation to reduce the risk of contamination by microorganisms from the air; ● incubating sealed Petri dishes at a maximum temperature of 25°C to avoid growth of pathogens; and ● cleaning work surfaces and hands and safely disposing of bacterial cultures by autoclaving;
The body's defence mechanisms	2.6.5 demonstrate knowledge and understanding of the body's defence mechanisms, including: ● the skin, mucous membranes and blood clotting; ● the production of antibodies by white blood cells (lymphocytes) in response to antigens; ● the role of antibodies in defence – antibody-antigen reaction, clumping, reduced spread of disease microorganism and symptoms; ● the role of phagocytes in engulfing and digesting microorganisms; ● the role of memory lymphocytes in a secondary response; and ● immunity, in terms of active and passive.

Content	Learning Outcomes
Plant defence mechanisms	Students should be able to: 2.6.6 demonstrate knowledge and understanding that plant defences against disease can be: • structures, limited to thick cell walls and waxy cuticle on leaves (Link to 1.2.6); and • chemicals, limited to antimicrobial, for example mint, or poisonous, for example digitalis from foxglove;
Development of medicines	2.6.7 demonstrate knowledge and understanding of how medicines are developed, including: • Fleming's discovery of penicillin and its later development for medical applications by Florey and Chain; • the role of careful observation and scientific process in the development of penicillin; • **the manufacture of drugs (penicillin) in a simple fermenter;** • **preclinical trials, using cells, tissues and living organisms, to check if the drug is poisonous and how effective it is;** • **clinical trials, using healthy volunteers to determine the optimum dosage of the drug (no details of trial procedures are required); and** • **the role of validation of research by peer review**;
Antibiotics	2.6.8 demonstrate knowledge and understanding that antibiotics, for example penicillin, are chemicals produced by fungi that are used against bacterial diseases to kill bacteria or reduce their growth; and • *investigate the effect of different chemicals or antibiotic discs on the growth of bacteria (Practical 2.3)*; **and**
Antibiotic-resistant bacteria	2.6.9 **demonstrate knowledge and understanding of the implications on the health of the population of:** • **overuse of antibiotics leading to bacterial resistance, resulting in the development of superbugs such as MRSA; and** • **procedures to reduce the incidence of superbugs and why they are difficult to eradicate.**

Content	Learning Outcomes
Vaccinations	Students should be able to: 2.6.10 demonstrate knowledge and understanding of the role of vaccines, including: ● the use of modified disease-causing organisms to produce raised antibody levels and memory lymphocyte levels in the blood; **and** ● **the role of booster vaccinations and the interpretation of graphs of blood antibody levels**;
Non-communicable diseases	2.6.11 recall that many non-communicable diseases may involve interactions between different types of disease and are caused by the interaction of these factors: ● inherited – some people may carry a gene that predisposes them to some cancers; and ● lifestyle, including: – poor diet: excess sugar and fat intake; – lack of exercise: energy used in exercise being lower than energy intake is the cause of obesity; – overexposure to the sun: ultraviolet (UV) radiation causes mutations leading to skin cancer; – misuse of drugs: - alcohol: binge drinking can cause liver disease and affect foetal development (foetal alcohol syndrome); - tobacco smoke: tar can cause bronchitis (narrowing of bronchi and bronchioles), emphysema (damage to alveoli reducing the surface area for gas exchange) and lung cancer (abnormal cell division); - nicotine is addictive and affects heart rate; and - carbon monoxide combines with red blood cells to reduce the oxygen-carrying capacity of the blood; and 2.6.12 describe the interactions between different types of disease: obesity causing cardiovascular diseases and Type 2 diabetes.

Content	Learning Outcomes
Heart attacks and strokes	Students should be able to: 2.6.13 demonstrate knowledge and understanding of the cause and effect of a blockage in a blood vessel: ● a blockage caused by a build-up of cholesterol deposits leads to clot formation; ● restricted blood flow means less oxygen and glucose reaching cells, and the resulting reduced cell respiration leads to cell death; ● a blockage in the coronary blood vessels restricts blood flow to the heart muscle and causes death of heart muscle cells (heart attack); and ● a blockage in the blood vessels to the brain causes death of brain cells, resulting in reduced brain function (stroke); 2.6.14 explain these treatments for cardiovascular disease: ● angioplasty and stents; and ● statins and aspirin; 2.6.15 recall that certain lifestyle factors increase or reduce the risk of heart disease and strokes (excess dietary fats, smoking, stress and lack of exercise);
Cancer	2.6.16 recall that uncontrolled cell division produces cancer cells, which can result in two types of tumour: benign (encapsulated and not spreading) and malignant (capable of spreading); 2.6.17 appreciate how lifestyle choices can affect the risk of developing certain types of cancer, for example cervical (HPV vaccine), lung (smoking) and skin (UV radiation); and 2.6.18 demonstrate knowledge and understanding of the importance of early detection in improving the survival rate of cancer patients, including screening programmes for breast, cervical, testicular and skin cancer.

Content	Learning Outcomes
Cancer (cont.)	Students should be able to: 2.6.19 appreciate the advantages and disadvantages of different treatment methods for cancer – surgery, radiotherapy, chemotherapy **and immunotherapy (injecting antibodies that attach to cancer cells allowing the body's immune system to destroy them)** (linked to 1.1.7).

3.3 Unit 3: Practical Skills

Units 1 and 2 include a number of practical tasks that students carry out during the course. Nine of these are prescribed practicals. This unit has two parts: Booklet A and Booklet B. We set and mark both booklets.

Booklet A is a practical, externally assessed examination. It assesses students' ability to carry out two practical tasks based on but not identical to the nine prescribed practicals listed in this specification.

Booklet B is a written, externally assessed examination taken during the final year of study. It assesses students' knowledge and understanding of practical science. It consists of questions about planning and carrying out any of the prescribed practical tasks, together with more general questions about any practical situation that arises in Units 1 and 2 in this specification.

Content	Learning Outcomes
Planning an investigation	Students should be able to: • identify the independent, dependent and controlled variables in an investigation; • make a hypothesis or prediction and explain their reasoning; • plan a method to test their prediction; • carry out a risk assessment on all planned practical activities; • select suitable equipment or apparatus that provides accurate results; • produce a results table with appropriate headings and units to record a suitable extent and range of data; • draw a diagram of the apparatus used in an experiment; and • demonstrate knowledge and understanding of the steps that they must take to ensure the reliability of data collected.

Content	Learning Outcomes
Carrying out an experiment **Analysing experimental data** **Drawing conclusions from an experiment**	Students should be able to: • demonstrate the practical skills needed to use apparatus correctly, skilfully and safely; • obtain and record accurate evidence and repeat the experiment when appropriate to ensure reliability of the results; • use appropriate scales and axis labels when plotting a graph of experimental data; • analyse, interpret and critically evaluate a range of experimental data; • plot data points accurately and draw the appropriate straight line or curve; • make deductions from given observations; • make reasoned judgements and draw evidence-based conclusions; • discuss in detail the areas of an investigation that could affect the reliability of the data or evidence collected, including accounting for any anomalous results; and • develop arguments and explanations, taking account of the limitations of the available evidence.

Content	Learning Outcomes
Prescribed practicals assessed in Unit 3 Booklet A and/or Booklet B	Students should be able to: • make a temporary slide and use a light microscope to examine and identify the structures of a typical plant and animal cell; • investigate the need for light and chlorophyll in photosynthesis by testing a leaf for starch; • investigate the energy content of food by burning food samples; • investigate the effect of temperature on the action of an enzyme; • investigate factors affecting the respiration of yeast; • use quadrats to investigate the abundance of plants and/or animals in a habitat; • investigate the process of osmosis by measuring the change in length or mass of plant tissue or model cells using Visking tubing; • use a photometer (bubble or weight photometer and/or washing line method) to investigate the factors affecting the rate of water uptake of a plant; and • investigate the effect of different chemicals or antibiotic discs on the growth of bacteria.

4 Scheme of Assessment

4.1 Assessment opportunities

For the availability of examinations and assessment, see Section 2.

This is a unitised specification; candidates must complete at least 40 percent of the overall assessment requirements at the end of the course, in the examination series in which they request a final subject grade. This is the terminal rule.

Candidates may resit individual assessment units **once** before cash-in. The better of the two results will count towards their final GCSE grade unless a unit is required to meet the 40 percent terminal rule. If it is, the more recent mark will count (whether or not it is the better result). Results for individual assessment units remain available to count towards a GCSE qualification until we withdraw the specification.

4.2 Assessment objectives

There are three assessment objectives for this specification. Candidates must:

AO1 demonstrate knowledge and understanding of:
- scientific ideas; and
- scientific techniques and procedures;

AO2 apply knowledge and understanding of and develop skills in:
- scientific ideas; and
- scientific enquiry, techniques and procedures; and

AO3 analyse scientific information and ideas to:
- interpret and evaluate;
- make judgements and draw conclusions; and
- develop and improve experimental procedures.

4.3 Assessment objective weightings

The table below sets out the approximate assessment objective weightings for each assessment component and the overall GCSE qualification.

Assessment Objective	Unit Weighting (%)			Overall Weighting (%)
	Unit 1	Unit 2	Unit 3	
AO1	15	16	9	40
AO2	15	17	8	40
AO3	5	7	8	20
Total Weighting	35	40	25	100

4.4 Quality of written communication

In GCSE Biology, candidates must demonstrate their quality of written communication. They need to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- select and use a form and style of writing that suit their purpose and complex subject matter; and
- organise information clearly and coherently, using specialist vocabulary where appropriate.

Quality of written communication is assessed in responses to questions and tasks that require extended writing.

4.5 Reporting and grading

We report the results of individual assessment units on a uniform mark scale that reflects the assessment weighting of each unit.

We determine the grades awarded by aggregating the uniform marks that candidates obtain in individual assessment units. We award GCSE qualifications on a grade scale from A* to G, with A* being the highest. The nine grades available are as follows:

Grade	A*	A	B	C*	C	D	E	F	G

If candidates fail to attain a grade G or above, we report their result as unclassified (U).

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 depends 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 performances in others.

Grade	Description
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. Candidates 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, including 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 judgements consistently and draw detailed, evidence-based conclusions.

Grade	Description
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, including 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.

Grade	Description
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.

6 Guidance on Practical Skills Assessment

6.1 Overview

Unit 3 assesses Practical Skills. It has two parts: Booklet A is a practical assessment and Booklet B is an examination.

All of the nine prescribed practicals should be taught throughout the course. Booklet A consists of two pre-release practical assessments based on but not identical to those on the list of nine prescribed practicals. We change the two assessed practicals every year to ensure that they continue to set an appropriate challenge and remain valid, reliable and stimulating.

In Booklet A, candidates carry out two practical tasks in the laboratory. Booklet A is a practical skills assessment and should be carried out under a high level of control, with an invigilator and teacher supervision to comply with health and safety regulations.

We send centres a list of the materials required for Booklet A in the December before the Summer submission. We send Booklet A to centres in January of the final year of study.

Candidates collect qualitative or quantitative results depending on the demands of the practical skills assessment. We will publish a timetabled period for this practical skills assessment on the examinations timetable. Centres must send Booklet A to us for marking.

Booklet B is a timetabled, externally assessed examination taken at the end of the final year of study. It consists of questions about planning and carrying out any of the prescribed practical tasks. It also has more general questions about any practical situation that arises from this specification.

6.2 Skills assessed by Unit 3

The following skills are assessed:

- planning an investigation;
- carrying out an investigation;
- analysing experimental data; and
- drawing conclusions from an experiment.

6.3 Task taking in Booklet A

Booklet A is a practical skills assessment and must be carried out under a high level of control.

An appropriate teacher should be present with an invigilator to ensure compliance with health and safety regulations.

Teachers and invigilators should not offer direction or guidance to candidates where this would assist them in completing Booklet A.

Foundation and Higher Tier candidates may carry out the practical skills assessment in the same room, but must work with others taking the same tier.

Candidates may work collaboratively in groups of up to three when carrying out the practical tasks, but must work individually and independently to complete Booklet A.

Candidates have **2 hours** to complete Booklet A in a single session.

If the experimental process of the practical assessment takes longer than **2 hours**, we will provide candidates with a separate practical instruction sheet specific to the practical. This sheet details the set up of the practical and any recording that candidates may have to carry out. The initial recording is not worth any marks. The time required for setting up the practical is not part of the **2 hours** allowed for completing Booklet A, as this extra time is only for set up or preparation purposes. This practical can only be set up a maximum of three days before candidates complete Booklet A. If candidates have recorded data on the practical instruction sheet, they will have access to this when completing Booklet A.

The examinations officer must keep all Booklet A papers (completed and unused) securely at all times.

Centres must return Booklet A papers to us for marking after 1 May.

We will provide additional information relating to Booklet A as a support document.

For Booklet A, the level of control for task taking is **high**. The table below exemplifies high levels of control for this practical skills assessment.

Areas of Control	**Detail of Control**
Authenticity	• Booklet A is an externally set and externally marked practical skills assessment. • Teachers must ensure that all candidates are in direct sight of the supervisor at all times. • Interaction between candidates is tightly prescribed during the practical tasks. • They should not communicate with each other when completing their response in Booklet A. • We will publish a timetabled period for this practical skills assessment on the examinations timetable. • Candidates must carry out the practical tasks and complete Booklet A in two hours. • We send an apparatus and materials list to examinations officers in December of the last year of study. They will distribute this list to the relevant head of department.
Feedback	• Teachers should not provide guidance or feedback during the practical skills assessment except to intervene on the grounds of health and safety.
Page Limit	• We set Booklet A. It has no prescribed page limit.
Collaboration	• Candidates for the same tier of entry may work collaboratively to carry out the practical tasks but they must provide an individual response in Booklet A.
Resources	• The only allowed additional resource is the GCSE Data Leaflet, if required.

7 Curriculum Objectives

This specification builds on the learning experiences from Key Stage 3 as required for the statutory Northern Ireland Curriculum. It also offers opportunities for students to contribute to the aim and objectives of the Curriculum at Key Stage 4, and to continue to develop the Cross-Curricular Skills and the Thinking Skills and Personal Capabilities. The extent of the development of these skills and capabilities will be dependent on the teaching and learning methodology used.

7.1 Cross-Curricular Skills at Key Stage 4

Communication
Students should be able to: • communicate meaning, feelings and viewpoints in a logical and coherent manner, using appropriate technical terms, *for example outline the process of eutrophication*; • make oral and written summaries, reports and presentations, which take account of audience and purpose, *for example describe some treatments for cardiovascular disease and explain when and how they are used and their benefits and drawbacks, in the form of a written or oral presentation*; • participate in discussions, debates and interviews, *for example the role of international treaties in combating increasing global CO_2 levels*; • interpret, analyse and present information in oral, written and ICT formats, *for example prepare a presentation or poster*; and • explore and respond, both imaginatively and critically, to a variety of texts, *for example re-evaluate the evidence for how environmental changes affect the distribution of organisms*.
Using Mathematics
Students should be able to: • use mathematical language and notation with confidence, *for example use appropriate units, measurements and calculations such as enzyme and transpiration experiments*; • select and apply mathematical concepts and problem-solving strategies in a range of simulated and real-life contexts, *for example during fieldwork work out average percentage cover of a species or average number of a species*; • interpret and analyse a wide range of mathematical data, *for example calculating the energy content in foods*; and • present mathematical data in a variety of formats that take account of audience and purpose, *for example a graphical representation of different examples of variation within a class*.

Using ICT
Students should be able to make effective use of information and communications technology in a wide range of contexts to access, manage, select and present information, including mathematical information, *for example use of data loggers to record experimental data about an abiotic factor during fieldwork and use of an appropriate format for presenting experimental results and conclusions*.

7.2 Thinking Skills and Personal Capabilities at Key Stage 4

Self-Management
Students should be able to: • plan work, *for example plan with others how they might carry out one of the prescribed practical tasks*; and • set personal learning goals and targets to meet deadlines, *for example learning how to use a scientific balance to find the mass of materials encountered through a prescribed practical*.
Working with Others
Students should be able to: • learn with and from others through co-operation, *for example plan and carry out an experiment with others to test a range of foods*; • participate in effective teams and accept responsibility for achieving collective goals, *for example carry out a series of practical tasks to complete a field survey*; and • listen actively to others and influence group thinking and decision-making, taking account of others' opinions, *for example research the benefits and risks of the use of stems cells in medicine*.

Problem Solving
Students should be able to: • identify and analyse relationships and patterns, *for example investigate experimentally the relationship between light and rate of photosynthesis and use ICT to process the data*; • propose justified explanations, *for example how numbers of organisms could increase or decrease*; • reason, form opinions and justify their views, *for example discuss issues with genetic screening*; • analyse critically and assess evidence to understand how information or evidence can be used to serve different purposes or agendas, *for example evaluate why the number of people with diabetes in the population is rising*; • analyse and evaluate multiple perspectives, *for example have a discussion on positive effects of human activity on biodiversity*; • explore unfamiliar views without prejudice, *for example evaluate the ethical issues associated with genetic screening*; and • weigh up options and justify decisions, *for example evaluate the advantages and disadvantages of various treatment methods for cancer*.

Although not referred to separately as a statutory requirement at Key Stage 4 in the Northern Ireland Curriculum, **Managing Information** and **Being Creative** may also remain relevant to learning.

8 Links and Support

8.1 Support

The following resources are available to support this specification:

- our Biology microsite at www.ccea.org.uk and
- specimen assessment materials;

We also intend to provide:

- past papers;
- mark schemes;
- Chief Examiner's reports;
- Principal Moderator's reports;
- guidance on progression from Key Stage 3;
- planning frameworks;
- centre support visits;
- support days for teachers;
- practical skills assessment guidance for teachers and candidates;
- a resource list; and
- exemplification of examination performance.

8.2 Examination entries

Entry codes for this subject and details on how to make entries are available on our Qualifications Administration Handbook microsite, which you can access at www.ccea.org.uk

Alternatively, you can telephone our Examination Entries, Results and Certification team using the contact details provided.

8.3 Equality and inclusion

We have considered the requirements of equality legislation in developing this specification and designed it to be as free as possible from ethnic, gender, religious, political and other forms of bias.

GCSE qualifications often require the assessment of a broad range of competences. This is because they are general qualifications that prepare students for a wide range of occupations and higher level courses.

During the development process, an external equality panel reviewed the specification to identify any potential barriers to equality and inclusion. Where appropriate, we have considered measures to support access and mitigate barriers.

We can make reasonable adjustments for students with disabilities to reduce barriers to accessing assessments. For this reason, very few students will have a complete barrier to any part of the assessment.

Students with a physical impairment may instruct a practical assistant to set up equipment but may have difficulty in making observations and in manipulating the equipment to carry out the experiment.

Students with a visual impairment may find elements of the assessment difficult, but technology may help visually impaired students to take readings and make observations. Therefore, the assessments should not pose a difficulty for these students.

It is important to note that where access arrangements are permitted, they must not be used in any way that undermines the integrity of the assessment. You can find information on reasonable adjustments in the Joint Council for Qualifications document *Access Arrangements and Reasonable Adjustments*, available at www.jcq.org.uk

8.4 Contact details

If you have any queries about this specification, please contact the relevant CCEA staff member or department:

- Subject Support Officer: Nuala Tierney
  (telephone: (028) 9026 1200, extension 2292, email: ntierney@ccea.org.uk)

- Subject Officer: Edith Finlay
  (telephone: (028) 9026 1200, email: efinlay@ccea.org.uk)

- Examination Entries, Results and Certification
  (telephone: (028) 9026 1262, email: entriesandresults@ccea.org.uk)

- Examiner Recruitment
  (telephone: (028) 9026 1243, email: appointments@ccea.org.uk)

- Distribution
  (telephone: (028) 9026 1242, email: cceadistribution@ccea.org.uk)

- Support Events Administration
  (telephone: (028) 9026 1401, email: events@ccea.org.uk)

- Moderation
  (telephone: (028) 9026 1200, extension 2236, email: moderationteam@ccea.org.uk)

- Business Assurance (Complaints and Appeals)
  (telephone: (028) 9026 1244, email: complaints@ccea.org.uk or appealsmanager@ccea.org.uk).

Appendix

Mathematical Content

Students need to be familiar with and competent in the following areas of mathematics in order to develop their skills, knowledge and understanding across this specification. These will be assessed across all three units.

Mathematical skills
Arithmetic and numerical computation
Recognise and use expressions in decimal form
Recognise and use expressions in standard form
Use ratios, fractions and percentages
Make estimates of the results of simple calculations
Handling data
Use an appropriate number of significant figures
Find arithmetic means
Construct and interpret frequency tables and diagrams, bar charts and histograms
Understand the principles of sampling as applied to scientific data
Understand simple probability
Make order of magnitude calculations
Algebra
Understand and use the symbols: =, <, <<, >>, >, $\propto$, ~
Graphs
Translate information between graphical and numeric form
Plot two variables from experimental or other data
Determine the slope and intercept of a linear graph
Geometry and Trigonometry
Use angular measures in degrees
Calculate areas of triangles and rectangles, surface areas and volumes of cubes.

The mathematics content above will be assessed throughout the lifetime of the specification.

COUNCIL FOR THE **CURRICULUM, EXAMINATIONS** AND **ASSESSMENT**
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