GCSE

Additional Science B

Gateway Science Suite

OCR GCSE in Additional Science J641

Foreword to the Second Edition

This Second Edition of the OCR GCSE Additional Science B specification has been produced to correct minor errors found in the original edition (published in Dec 2005). There are no changes to actual content or the scheme of assessment.

Section 6.6 has been updated (amended in Oct 2007).

QAN 100/5633/6

Contents

1 About this Qualification

1.1 About the Gateway Science Suite

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 and Heinemann.

Centres wishing to include GCSE Additional Applied Science in their provision are advised to consider the specification which is part of the Twenty First Century Science Suite A.

1.2 About this Additional Science Specification

This booklet contains OCR's GCSE specification in Additional Science for teaching from September 2006 and first certification in June 2008.

The primary objective of this specification is to interest and engage candidates in science.

This is achieved by:

- identifying activities and experiences which will excite their interest, and linking these to scientific ideas and their implications for society;
- providing opportunities to develop science explanations and theories;
- providing a scheme of assessment which gives regular feedback.

This approach will appeal to candidates of all abilities. The specification emphasises the teaching and learning activities of the course, from which emerge the learning outcomes.

This specification comprises six teaching modules which are assessed through three units. Candidates take all three units.

Unit	Unit Code	Title	Duration	Weighting	Total Mark
1	B623	Additional Science B Unit 1 – modules B3, C3, P3	1 hour	33⅓%	60
2	B624	Additional Science B Unit 2 – modules B4, C4, P4	1 hour	33⅓%	60
3	B626	Additional Science B Unit 3 – Research Study, Data Task and Practical Skills	-	33⅓%	60

1.3 Qualification Titles and Levels

This qualification is shown on a certificate as OCR GCSE in Additional Science.

This qualification is approved by the regulatory authorities (QCA, ACCAC and CEA) as part of the National Qualifications Framework (NQF).

Candidates who gain grades G to D will have achieved an award at Foundation Level (Level 1 of the NQF).

Candidates who gain grades C to A* will have achieved an award at Intermediate Level (Level 2 of the NQF).

1.4 Aims

This specification therefore aims to give candidates opportunities to:

- develop their interest in, and enthusiasm for, science;
- 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.

OCR has taken great care in the preparation of this specification and assessment material to avoid bias of any kind.

1.5 Prior Learning/Attainment

Candidates who are taking courses leading to this qualification at Key Stage 4 should normally have followed the corresponding Key Stage 3 programme of study within the National Curriculum.

Other candidates taking this course should have achieved a general educational level equivalent to National Curriculum Level 3.

Candidates taking this course will normally have already taken, or be taking at the same time, a course leading to a GCSE in Science.

2 Summary of Content

The specification content is presented as six modules, predominantly Biology, Chemistry and Physics. Within each module the content is shown as eight items (e.g. B3a, B3b, B3c, B3d, B3e, B3f, B3g, B3h). Thus, the specification content contains a total of 48 teaching items. Each item is approximately 2½ hours teaching time.

Module B3: Living and growing

a Molecules of Life
b Diffusion
c Keep it moving
d Divide and Rule
e Growing Up
f Controlling Plant Growth
g New Genes for Old
h More of the Same

Module B4: It's a Green World

a Who planted that there
b Water, water everywhere
c Transport in plants
d Plants need minerals too
e Energy flow
f Farming
g Decay
h Recycling

Module C3: The Periodic Table

Fundamental Chemical Concepts
a What are atoms like?
b How atoms Combine – Ionic Bonding
c Covalent bonding and the Structure of the Periodic Table
d The Group 1 Elements
e The Group 7 Elements
f Electrolysis
g Transition Elements
h Metal Structure and Properties

Module C4: Chemical Economics

Fundamental Chemical Concepts
a Acids and Bases
b Reacting Masses
c Fertilisers and Crop yield
d Making ammonia – Haber Process and costs
e Detergents
f Batch or Continuous
g Nanochemistry
h How pure is our water?

Module P3: Forces for Transport

a Speed
b Changing Speed
c Forces and Motion
d Work and Power
e Energy on the Move
f Crumple Zones
g Falling Safely
h The Energy of Game and Theme Rides

Module P4: Radiation for Life

a Electrostatics – Sparks
b Electrostatics 2: uses of electrostatics
c Safe Electricals
d Ultrasound
e Treatment
f What is radioactivity
g Uses of radioisotopes
h Fission

3 Content

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 OURSELVES)

Item code and title: e.g. B1a: Fit for life

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 activities and experiences 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

Can-Do tasks

Tasks linked to the learning activities in this item which can be used for the practical skill assessment element (Can-Do tasks). The number of points for successful completion of the task are also given.

e.g. I can measure blood pressure 1 point

MODULE CODE AND TITLE

Links to other modules: 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

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

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, and the role of an essential group of proteins, enzymes. This item provides the opportunity to collect and analyse scientific data from primary or secondary sources to test a scientific idea and explain phenomena using scientific theories, models and ideas.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Make a cheek cell slide and examine using a microscope.	Relate a cheek cell slide to the structure and function of the cell: • nucleus carries genetic information; • cell membrane controls the movement of substances in and out of cells; • cytoplasm is where many chemical reactions happen.
Use of 'Cake Workshop'. • 'Recipe for Life' – an activity to demonstrate use of a recipe (code); • 'DNA a chemical recipe' – role play activity to illustrate pairing up of bases. See www.bbsrc.ac.uk	State that chromosomes in the nucleus carry coded information in the form of genes which are made of a chemical called DNA. Recall that proteins are needed for the growth and repair of cells.
Examine DNA 'fingerprinting' results.	State that a person's DNA is unique.
Build plasticine models to illustrate 'lock and key' mechanism. Investigate the effects of changing temperature or pH on enzyme activity.	State that an enzyme will speed up a chemical reaction.

MODULE B3: LIVING AND GROWING

Links to other modules: B1a Fit for Life, B1b What's for Lunch?, B1g Gene Control, B2c The Food Factory, B3b Diffusion, B3d Divide and Rule, B3e Growing Up, B4d Plants need minerals too B6a Understanding Bacteria

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Identify the mitochondria in an animal cell. State that respiration occurs in the mitochondria providing energy for life processes.	
Describe the structure of DNA as a double helix with cross links formed by 2 bases. State that before cells divide the DNA copies itself (DNA replication). State that DNA controls the production of different proteins (protein synthesis). State that each gene codes for a particular protein. State that proteins are made of chains of amino acids. State that we use amino acids from our diet to make proteins.	Describe the complementary base pairings: A -T and G – C. Describe DNA replication: • 'unzipping' to form single strands; • new double strands forming by complementary base pairing. Explain that protein structure is determined by the DNA base code: • base sequence determines amino acid sequence; • each amino acid is coded for by a sequence of 3 bases. State that the body can change some amino acids into others (transamination) in the liver.
Interpret data on DNA 'fingerprinting' for identification.	State the stages in the production of a DNA 'fingerprint' (isolation, fragmentation, separation and comparison with a reference).
State that enzymes are proteins. State that enzymes are biological catalysts. Describe how changing temperature and pH will change the rate of reaction of an enzyme-catalysed reaction: • optimum pH; • optimum temperature. State that enzymes have a high specificity for their substrate. State that enzymes catalyse the chemical reactions occurring in living cells: respiration, photosynthesis, protein synthesis.	State that each protein has its own number and sequence of amino acids, resulting in different shaped molecules which have different functions. Explain the specificity of enzymes in terms of the 'lock and key' mechanism. Explain how enzyme activity is affected by pH and temperature: • optimum pH; • optimum temperature; • denaturing at extremes of pH and high temperatures; • denaturing is an irreversible change inhibiting enzyme function; • denaturing changes the shape of the active site.

MODULE B3: LIVING AND GROWING

Item B3b: Diffusion

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. This item examines the process itself and a variety of situations where it occurs. Making a model cell provides the opportunity to work accurately and safely when collecting data and to consider the reliability and validity, present the results and draw a conclusion using scientific and technical language. This also provides experience of developing and using a scientific model.

Suggested activities and experiences 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.	State that substances move in and out of cells through the cell membrane.
Make a model cell using visking tubing and investigate which of sugar and starch can pass through; this could be extended to investigate the effect of changing temperature on the rate of diffusion of sugar.	State that oxygen enters the blood in the lungs and leaves the blood in body tissues. State that carbon dioxide enters the blood in body tissues and leaves in the lungs. State that food enters the blood in the small intestine and leaves in body tissues.
Research the role of the placenta both to allow the movement of some substances and to act as a barrier to prevent the movement of other substances.	Apply research on role of placenta to show that: • developing foetus requires food and oxygen from its mother; • the developing foetus passes carbon dioxide and waste to its mother.
	State that carbon dioxide and oxygen move in and out of plants through the leaves.
	State that water is lost from plants by evaporation from the leaves.

MODULE B3: LIVING AND GROWING

Links to other modules: B1a Fit for Life, B1b What's for Lunch?, B1d Keeping in Touch, B3a Molecules of life, B3c Keep it Moving, B4a Who planted that there?, B4b Water, water everywhere, B5d Breath of Life

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe diffusion as the movement of a substance from a region of high to low concentration. Describe how molecules enter and leave cells by diffusion through the cell membrane.	Explain that diffusion is the net movement of particles from an area of high concentration to an area of low concentration and is a consequence of the random movement of individual particles. Explain that the rate of diffusion is increased by: • a shorter distance; • a greater concentration difference (gradient); • a greater surface area.
Describe how small digested food molecules are absorbed into the blood in the small intestine by diffusion. Describe gaseous exchange within alveoli by diffusion between air and blood.	Explain how the alveoli are adapted for efficient gaseous exchange: permeable, moist, large surface area, good blood supply, wall one cell thick. Explain how the small intestine is adapted for the absorption of food: long, large surface area (villi and microvilli); permeable surface, good blood supply.
Describe how food and oxygen reach the foetus, and carbon dioxide and other wastes are removed, by diffusion through the placenta.	Explain how the placenta is adapted to increase the rate of diffusion.
	Explain how transmitter substances diffuse across synapses to carry signals from one neurone to the next.
Describe how carbon dioxide and oxygen diffuse in and out of plants through the leaves.	Explain how leaves are adapted to increase the rate of diffusion of carbon dioxide and oxygen.
Explain the loss of water from leaves in terms of the diffusion of water molecules.	

MODULE B3: LIVING AND GROWING

Item B3c: Keep it Moving

Summary: If we lose blood in an accident it can be very serious, even fatal. This item 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. Investigating the effect of exercise on heart/pulse rate illustrates the use of ICT phenomena.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey of family / friends to find out who has given blood and their reasons for giving or not giving. Design a leaflet or web-page encouraging people to give blood.	State the functions of cells in the blood: • red blood cells transport oxygen; • white blood cells defend against disease; • platelets help blood clotting.
Research and present a report on disorders of the blood e.g. haemophilia, sickle cell anaemia, leukaemia. Research what to do if someone has a cut and is bleeding badly.	State that the blood moves around the body in: • arteries; • veins; • capillaries.
Examine an animal heart (or model). Measure heart / pulse rate. Investigate effect of exercise on heart/ pulse rate. (ICT opportunity for data-logging).	Describe the functions of the heart: • pumps blood to the lungs; • The right side of the heart punps blood to the lungs; • The left side of the heart pumps blood to the rest of the body. State that blood in arteries is under higher pressure that in the veins.
Use websites to plan for a lower cholesterol intake.	State that cholesterol can build up in arteries and restrict or block blood flow.
Research causes of heart disease.	Describe one way the heart and parts of the heart can be replaced: • mechanically; • biologically.

MODULE B3: LIVING AND GROWING

Links to other modules: B1a Fit for Life, B1b What's for Lunch?, B1c Keeping Healthy, B1f Staying in Balance, B3b Diffusion, B5b The vital pump, 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 how the structure of a white blood cell is adapted to its function: • flexible shape to engulf disease organisms. State the function of plasma in transporting foods, hormones, antibodies, water, waste products around the body.	Explain how the structure of a red blood cell is adapted to its function: • small size provides large surface area to volume ratio. Explain that haemoglobin in red blood cells reacts with oxygen in the lungs forming oxyhaemoglobin and 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: • arteries transport blood away from the heart; • veins transport blood to the heart; • capillaries are involved in exchange of materials with tissues.	Explain the adaptations of arteries, veins and capillaries to their functions: • thick muscular and elastic wall in arteries; • large lumen and presence of valves in veins; • permeability in capillaries.
State the names and positions of the parts of the heart and describe their functions: • 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. • higher pressures and therefore greater rate of flow to the tissues.
Explain that the amount of cholesterol in arteries is linked to diet.	Describe how cholesterol can build up to form a plaque which can restrict or block blood flow in arteries.
State problems in supply of donor hearts: shortage of donors, tissue match, size, age. State other problems with transplants: • rejection and necessary drug regime. Describe problems of using mechanical replacements: • size; • power supply; • body reactions.	Describe the advantages and disadvantages of a heart pacemaker and heart valves, over a heart transplant.

MODULE B3: LIVING AND GROWING

Item B3d: Divide and Rule

Rationale: As living things grow, the number of cells in them increases. This item looks at the two ways cells divide, mitosis and meiosis, and the differences between them. Software simulations and video clips which show cell division are uses of ICT in teaching and learning. Using models to illustrate cell division provides experiences of explaining phenomena.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Watch a video, examine photographs, use software simulations on cell division. Use models to illustrate cell division, using e.g. 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.	Explain that cells dividing during: • growth; • replacement of worn out cells; • repair to damaged tissue.
Examination of bull's sperm using a microscope. Examine a hen's egg to show the large amount of stored food.	State that in sexual reproduction sex cells (gametes) join (fertilisation). Explain how the structure of a sperm cell is adapted to its function: • small size and tail for swimming; • nucleus carries genes; • produced in large numbers to increase chance of fertilisation. Explain how the structure of an egg cell is adapted to its function: • large size as contains food source; • nucleus carries genes.

MODULE B3: LIVING AND GROWING

Links to other modules: B1a Fit for Life, B1g Gene Control, B3a Molecules of Life, B3e Growing Up, B3h More of the Same B5h Size Matters

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain the advantages of being multi-cellular: • allows organism to be larger; • allows for cell differentiation; • allows organism to be more complex. State that new cells for growth are produced by mitosis. State that in mammals, body cells are diploid (two of each chromosome).	Explain the advantages of being multi-cellular: • a single large cell has a smaller surface area / volume ratio reducing movement of materials in and out of cell. Explain that in mitosis the chromosomes: • are copied to produce genetically identical cells; • divide to opposite poles of the cell.
State that, at fertilisation, gametes combine to form a diploid zygote. State that gametes are produced by meiosis. State that gametes are haploid (one of each chromosome). State that meiosis introduces variation. Explain how the structure of a sperm cell is adapted to its function: • many mitochondria provide energy; • acrosome releases enzyme to digest egg membrane.	Explain that in meiosis the: • chromosome number is halved and each cell is different; • pairs of chromosomes separate to opposite poles of the cell in the first division; • chromosomes divide to opposite poles of the cell in the second division.

MODULE B3: LIVING AND GROWING

Item B3e: Growing Up

Summary: The growth of children is closely monitored and follows a recognisable pattern. Animals and plants grow in different ways. This item explores some of these differences. Research about 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 activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Make an onion cell slide and examine it using a microscope.	Identify the chloroplasts, vacuole and cell wall in a plant cell. State that the vacuole contains cell sap and helps provide support. State that the cell wall provides support. Describe how to make a stained slide of an onion cell.
Research about human stem cells. Research cancer (uncontrolled growth of undifferentiated cells).	State that growth involves both cell division and cell differentiation. State that cell differentiation involves producing different types of cells.
Plot data on weight gain of baby using a case study or collected data. See Personal Child Health Record from Local Health Authority.	State the main phases of human growth: • infancy; • childhood; • adolescence (puberty); • maturity (adulthood); • old age.

MODULE B3: LIVING AND GROWING

Links to other modules: B1g Gene Control, B2c The Food Factory, B3a Molecules of Life, B3d Divide and Rule, B4a Who planted that there?, B4b Water, water everywhere B3f Controlling Plant Growth, B5h Size Matters, B6a Understanding Bacteria.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the similarities and differences between plant and animal cells: • nucleus, membrane, cytoplasm in plant and animal cells; • chloroplasts, cell wall, large vacuole in plant cells only. Describe how animal and plant growth is different: • animals tend to grow to a finite size but many plants can grow continuously.	Describe how plant cell growth differs from animal cell growth: • cell enlargement is the main method by which plants gain height; • cell division is mainly restricted to the tips of shoots and roots; • many plant cells retain the ability to differentiate but most animal cells lose it at an early stage.
State that undifferentiated cells called stem cells can develop into different cells, tissues and organs.	Discuss issues arising from stem cell research.
Explain why gestation periods differ in different animals. State that different parts of a foetus and a baby grow at different rates. Plot data on babies' overall weight and head size. Describe the main phases of human growth: • infancy; • childhood; • adolescence (puberty); • maturity (adulthood); • old age. Interpret data on human growth.	Explain how data on babies' weight and head size can provide early warning of growth problems.

MODULE B3: LIVING AND GROWING

Item B3f: 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, evaluation of data collection and the validity and reliability of the data.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
	State that plant hormones are chemicals that control: • growth of shoots and roots; • flowering; • ripening of fruits.
Carry out an experiment to test whether cress seedlings grow towards light. Carry out an experiment to test whether bean roots always grow downwards.	Describe an experiment to show that shoots grow towards light. State that roots grow downwards in response to gravity.
Take cuttings using rooting powder to encourage root growth. Research how seedless grapes are produced. Investigate whether bananas ripen more quickly if already-ripened bananas are close by; research why this happens.	State that plant hormones can be used in agriculture to speed up or slow down plant growth.

MODULE B3: LIVING AND GROWING

Links to other modules: B3e Growing Up

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that shoots are positively phototropic but negatively geotropic. State that roots are negatively phototropic but positively geotropic. State that plant hormones (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 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. Genes can also change without human intervention. This is known as mutation. Debating the arguments for and against GM ingredients 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 activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
	State that gene mutations are changes to genes.
Research examples of different animal and plant breeds that have been produced by selective breeding.	Recognise features of plants and animals that might be selected for enhancement in a breeding programme.
Survey foods that contain GM ingredients. Debate the arguments for and against GM ingredients. Research the differences between gene therapy and germ line treatment as possible treatments for genetic disorders.	State that genes can be transferred from one living organism to another and that this is called genetic engineering or genetic modification. Recognise features of plants and animals that might be selected for in a genetic engineering programme.

MODULE B3: LIVING AND GROWING

Links to other modules: B1g Gene Control, B6h Genetic Engineering

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain that mutations are usually harmful but may be beneficial. Mutations can be caused by radiation, chemicals, or occur spontaneously.	Explain that mutations change the DNA base sequence, changing or preventing the production of the protein, that the gene normally codes for.
Describe the process of selective breeding involving the: • selection characteristics; • cross breeding; • selection of suitable offspring over many generations. Explain how selective breeding can contribute to improved agricultural yields.	Explain that a selective breeding programme may reduce the gene pool leading to problems of inbreeding: • accumulation of harmful recessive characteristics; • reduction in variation.
Explain some potential advantages and risks of genetic engineering and selective breeding: • advantage – production of organisms with new features; • disadvantage – inserted genes may have unexpected harmful effects. Describe, in outline only, some examples of genetic engineering: • taking the genes from carrots 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 in Vitamin A); • the production of human insulin by genetically engineered bacteria; • transferring resistance to herbicides, frost damage or disease to crop plants.	Describe the principles of genetic engineering: • selection of characteristics; • isolation of genes; • insertion; • replication. Discuss the moral and ethical issues involved in genetic modification weighed against the potential benefits.

MODULE B3: LIVING AND GROWING

Item B3h: More of the same

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 activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Research information on the techniques used to produce Dolly, the first cloned mammal.	Interpret information on cloning techniques to show that: • cloning is an example of asexual reproduction; • cloning produces genetically identical copies (clones). State that Dolly the sheep was the first mammal cloned from an adult. State that identical twins are naturally occurring clones.
Carry out a meristem tissue culture using cauliflower.	Describe how, in asexual reproduction, cell division produces new individuals. Describe how spider plants, potatoes and strawberries reproduce asexually. Describe how to take a cutting.