OCR
RECOGNISING ACHIEVEMENT

GCSE

Biology B

Gateway Science Suite

OCR GCSE in Biology B J643

Foreword to the Third Edition (October 2008)

This Third Edition of the OCR GCSE Biology B specification has been produced to include the changes to the wording of the Science in the News Level of Response Grid. These changes are intended to assist teachers in interpreting the qualities to be assessed.

The revised Level of Response Grid is in Section 5.2 (pg 113). Section 6.7 has been updated to be in line with other GCSE Specifications.

QAN 100/5635/X

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 Biology Specification

This booklet contains OCR's GCSE specification in GCSE Biology B 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 link 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 Units 1 and 2 and either Unit 3 or Unit 4.

Unit	Unit Code	Title	Duration	Weighting	Total Mark
1	B631	Biology B Unit 1 – modules B1, B2, B3	1 hour	33⅓%	60
2	B632	Biology B Unit 2 – modules B4, B5, B6	1 hour	33⅓%	60
3	B635	Biology B Unit 3 – 'Can-Do' tasks and report on Science in the News	-	33⅓%	60
4	B636	Biology B Unit 4 – 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 Biology.

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.

Close links with the Entry Level course are emphasised by grouping the Entry Level 'items' and relating them to the items of this specification.

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

2 Summary of Content

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

Module B1: Understanding Ourselves	Module B2: Understanding Our Environment	Module B3: Living and Growing
a Fit for Life	a Ecology in our School Grounds	a Molecules of Life
b What's for Lunch?	b Grouping Organisms	b Diffusion
c Keeping Healthy	c The Food Factory	c Keep it Moving
d Keeping In Touch	d Compete or Die	d Divide and Rule
e Drugs and You	e Adapt to Fit	e Growing Up
f Staying in Balance	f Survival of the Fittest	f Controlling Plant Growth
g Gene Control	g Population out of Control?	g New Genes for Old
h Who am I?	H Sustainability	h More of the Same
Module B4: It's a Green World	**Module B5: The Living Body**	**Module B6: Beyond the Microscope**
a Who planted that there?	a In good shape	a Understanding bacteria
b Water, water everywhere	b The vital pump	b Harmful micro-organisms
c Transport in plants	c Running Repairs	c Micro-organisms –factories for the future?
d Plants need minerals too	d Breath of Life	d Biofuels
e Energy Flow	e Waste Disposal	e Life in soil
f Farming	f Life Goes On	f Microscopic life in water
g Decay	g New for Old	g Enzymes in Action
h Recycling	h Size matters	h Genetic engineering

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 B1: UNDERSTANDING OURSELVES

Item B1a: Fit for Life

Summary: Exercise is an important part of our lives. This item looks at ways of measuring and explaining fitness. During exercise humans release energy in the process called respiration. This item provides the opportunity to collect and analyse scientific data from primary and secondary sources, including the use of ICT sources and tasks when assessing and monitoring fitness. Candidates can gain the skills of working accurately and safely, individually and with others to collect first-hand data when investigating pulse recovery times.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Use a blood pressure monitor (possible data logging).	State that blood in arteries is under pressure.
Visit a fitness centre, or have a visit from a representative and prepare a report on an individual fitness programme, including how ICT is used in assessing and monitoring fitness.	Explain that blood is under pressure: • due to contraction of heart muscles; • so that it reaches all parts of the body.
	State that glucose reacts with oxygen in cells to release energy and that this process is called respiration.
Carry out a fist clenching exercise with arm raised and then lowered to demonstrate muscle fatigue. Carry out a weight lifting exercise by a finger to show muscle fatigue. Carry out experiments on pulse recovery times and compare data using ICT skills.	Describe that during exercise, breathing and pulse rates increase: • to deliver oxygen and glucose to muscles more quickly; • to remove carbon dioxide from muscles more quickly. Describe an experiment to measure pulse rate recovery times. Analyse given data from a pulse rate experiment.

Can-Do Tasks

I can measure blood pressure.	1 point
I can measure breathing rate/pulse rate before and after different types of exercise.	1 point
I can do an experiment on fatigue in finger muscles and record the results.	2 points

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B1f Staying in Balance, B2c The Food Factory, B3a Molecules of Life, B3b Diffusion, B3c Keep it Moving, B3d Divide and Rule, B4h Recycling, B4d Plants need minerals too, B6c Microorganisms-factories for the future?

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that blood pressure measurements consist of diastolic and systolic information in mmHg.	Explain the possible consequences of having high blood pressure (burst blood vessels, damage to brain, stroke, kidney damage) or low blood pressure (dizziness, fainting, poor circulation).
Describe how blood pressure will vary according to age and lifestyle (diet, exercise, weight, alcohol intake and stress).	Discuss different ways of measuring fitness (strength, stamina, flexibility, agility, speed, as well as cardiovascular efficiency).
Explain the difference between fitness (physical activity) and health (free from infection).	
State and use the word equation for respiration with oxygen (aerobic respiration): glucose + oxygen → carbon dioxide + water (+ energy)	State and use the symbol equation for aerobic respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ energy)
Explain that during hard exercise, the oxygen supply is insufficient to meet energy demands so anaerobic respiration takes place in addition to aerobic respiration. State that this produces lactic acid which accumulates in muscles causing pain and fatigue. State the word equation for anaerobic respiration: glucose → lactic acid (+ energy) State that anaerobic respiration releases much less energy than aerobic respiration.	Explain fatigue in terms of lactic acid build up (oxygen debt) and how this is removed during recovery: • hard exercise causes lack of oxygen in cells; • incomplete breakdown of glucose; • continued panting replaces oxygen allowing aerobic respiration; • increased heart rate ensures blood carries lactic acid away to the liver.

MODULE B1: UNDERSTANDING OURSELVES

Item B1b: What's for Lunch?

Summary: The populations of many countries in the world are either underweight and starving or obese with associated health problems. This item looks at food as a source of energy and raw materials, how it is digested and considers the effects of diet on candidates' bodies. This item provides the opportunity to collect and analyse scientific data from primary and secondary sources, including the use of ICT tasks, when investigating individuals' energy intake and countries facing food emergencies. Recording a day's intake of protein and experiments to investigate digestion provide opportunities to work safely and accurately, individually and with others. Research on countries having food emergencies provides the opportunity to discuss ethical issues raised by science and technology.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Compare the food and nutritional value of different breakfast cereals. Record a day's food intake and calculate the total energy intake.	Recall that food is defined as being an energy source for living organisms. Recall the main uses of carbohydrates and fats (high energy source) and proteins (growth and repair, only used as an energy source in an emergency). Describe a balanced diet as one which also includes nutrients such as minerals (such as iron to make haemoglobin), vitamins (such as vitamin C to prevent scurvy), fibre (to prevent constipation) and water; these do not provide energy.
Use ICT tasks, including video clips, to research countries having food emergencies and facing starvation. Calculate personal recommended protein intake. Record a day's intake and calculate the amount of protein.	Recall that diets in many parts of the world are deficient in protein. Describe why a high protein diet is necessary for growing teenagers. Recall that being very overweight (obese) is linked to increased health risks such as arthritis, heart disease, diabetes, breast cancer. Interpret simple data on diet.
Investigate digestion of starch, protein and fat using simple food tests where appropriate.	State that physical digestion is breaking food into smaller pieces to pass more easily through the digestive system: chewing in the mouth; squeezing in the stomach.

Can-Do Tasks	
I can carry out simple food tests.	2 points
I can calculate a BMI and make a decision as to what it indicates.	2 points
I can carry out an experiment on enzyme action and record the results and conclusion.	3 points

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B3a Molecules of Life, B3b Diffusion, B3c Keep It Moving, B5h Size Matters, B6g Enzymes in Action

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain that a balanced diet will vary depending on the age, gender, and activity of the individual. Recall that carbohydrates are made up of simple sugars such as glucose, fats of fatty acids and glycerol, proteins of amino acids.	Discuss the influences of religion, personal choice, (e.g. vegetarians, vegans) and medical issues (e.g. food allergies) on a person's diet.
Recall that protein deficiency (kwashiorkor) is common in developing countries. Recall that proteins of animal origin are called 'first class proteins' because they contain all essential amino acids (these cannot be made by the body). Calculate the recommended daily average protein intake using the formula: RDA in g = 0.75 x body mass in kg Calculate the Body Mass Index given the formula: BMI = mass in kg / (height in m)^2 and use it as a guide to understand the terms underweight, normal, overweight, obese.	Explain how a desire for perfection, low self-esteem, poor self image can lead to a poor diet and the increased risks involved.
Explain that in chemical digestion the digestive enzymes break down large food molecules into smaller ones for absorption into the blood plasma or lymph. Recall that carbohydrates, fats and proteins are digested by specific enzymes (carbohydrases, lipases and proteases) in the mouth, stomach and small intestine. State that stomach acid aids enzyme function. Recall that small molecules are absorbed into the blood in the small intestine by diffusion.	Explain that bile improves fat digestion in the small intestine by the emulsification of fat droplets providing a larger surface area for enzyme action.

MODULE B1: UNDERSTANDING OURSELVES

Item B1c: Keeping Healthy

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey of diseases suffered by candidates in class or year (limited to flu/colds, athlete's foot, "stomach upsets") using primary or secondary sources.	State that infectious diseases are caused by pathogens (disease-causing microorganisms) such as fungi, bacteria, viruses and protozoa. Recall one example of a disease caused by each type of pathogen limited to athlete's foot (fungus), flu (virus), cholera (bacteria) and dysentery (protozoa).
	Describe how the human body is defended against pathogens by: • the skin; • blood clotting; • mucous membranes in the respiratory system; • hydrochloric acid in the stomach. Describe the difference between infectious and non-infectious diseases.
Chart the immunisation programme recommended for children up to the age of 16. Role playing exercise and data analysis, from SATIS 9, The Chinese Cancer Detectives. Use a world map to plan holidays and estimate the risk of exposure to diseases such as malaria, cholera, hepatitis, polio and typhoid.	State that immunisation gives protection from certain pathogens. Describe how pathogens that enter the body are dealt with by the immune system (destroyed by white blood cells which engulf them or produce antibodies). Interpret data on the incidence of disease around the world to show links with climate and socio-economic factors.
	State that new medical treatments/drugs are tested before use.
Can-Do Tasks I can collect data from various sources for a named disease and identify danger sites on a world map. 2 points	

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B3c Keep It Moving, B6a Understanding Bacteria, B6b Harmful Micro-organisms

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State the meaning of the terms parasite and host with reference to malaria. Describe how vectors spread disease: • limited to mosquito.	Explain how knowledge of the way in which vectors spread disease can help control infections: • limited to mosquito.
State that disease and other disorders can be caused by vitamin deficiency (scurvy), mineral deficiency (anaemia), body disorders (diabetes, cancer), genetic inheritance (red-green colour deficiency). Describe changes in lifestyle and diet which may reduce the risk of some cancers.	Describe the difference between benign and malignant tumours. Interpret data on types of cancer and survival/mortality rates.
State that the symptoms of an infectious disease are caused by cell damage or by toxins produced by the pathogens. Recall that antibodies lock on to antigens causing the death of the pathogens. Describe how immunity to pathogens comes from prior infection. Explain the difference between passive and active immunity. State that antibiotics can be used to treat bacterial and fungal infections.	Explain how each pathogen has its own antigens and that specific antibodies are needed. Explain the process of immunisation: • harmless pathogen given, this carries antigens, antigens trigger immune response by producing antibodies, immunity remains. Discuss the benefits and risks associated with immunisation. Explain the need for careful use of antibiotics to prevent the increase of resistant strains such as MRSA.
Explain why new treatments are tested using animals, human tissue, computer models and understand objections to some forms of testing.	Describe the use of blind and double blind trials in testing new drugs against placebos.

MODULE B1: UNDERSTANDING OURSELVES

Item B1d: Keeping In Touch

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment to find my range of vision using cardboard marked out in degrees or moving outstretched arms forward. Demonstrate binocular vision by bringing pencil points together at arm's length using one then two eyes.	Relate the body's sense organs (receptors) to the information they gather such as: skin – pressure, temperature and pain (touch); tongue – chemicals in food (taste); nose – chemicals in air (smell); eyes – light (sight); ears – sound (hearing) and balance. Name and locate the main parts of the eye: cornea, iris and pupil, lens, retina, optic nerve, blind spot.
Investigate why some animals have binocular vision and others do not.	Describe the difference between monocular and binocular vision.
Carry out a survey on eye defects (candidates wearing glasses/contact lens) or use second hand data, in class or year group. Use colour vision deficiency charts.	State the main problems in vision limited to long-sight, short-sight and red-green colour blindness.
Carry out an experiment using blunt needles or forceps to determine the frequency of nerve endings in different skin areas. Carry out experiments on reaction times using ICT. Research allowable reaction times in races.	Name and locate the main parts of the nervous system: the central nervous system (CNS) (brain and spinal cord); the peripheral nervous system. State that the nerve impulse is mainly electrical and is carried by nerve cells called neurones. State that reflex actions are fast, automatic and protective responses. State examples of reflex actions such as knee jerk, pupil reflex, withdrawing hand from a hot plate. Understand that voluntary responses are under the conscious control of the brain.

Can-Do Tasks

I can measure my field of view.	1 point
I can use Ishihara colour charts to identify colour vision deficiency.	1 point
I can collect, present and analyse data to compare the sensitivity of different areas of my skin.	2 points

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B1e Drugs and You, B2e Adapt to Fit, B3b Diffusion

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the functions of the main parts of the eye: cornea - refracts light; iris - controls how much light enters pupil; lens - focuses light on to retina; retina - contains light receptors; optic nerve - carries impulses to the brain. Describe the pathway of light through the eyeball, being refracted by the cornea and lens.	Understand how the eye focuses light by changing the shape of the lens (accommodation) – role of suspensory ligaments and ciliary muscle.
Describe how binocular vision is important in judging distance. Explain advantages and disadvantages of different types of vision.	
State that long and short-sight is caused by the eyeball or the lens being the wrong shape. State that red-green colour blindness is an inherited condition and is the result of lack of specialised cells in the retina.	Understand the problems of slow or poor eye accommodation in senior citizens. Recall that long and short-sight can be corrected by different lenses in glasses or contact lenses or by cornea surgery, convex and concave lenses respectively.
Name and locate the parts of a motor neurone (cell body, axon, sheath). State that the nerve impulse is carried in the axon of a neurone. Describe a reflex arc: stimulus → receptor →sensory neurone → central nervous system → motor neurone → effector → response. Describe the path taken by a spinal reflex involving a receptor, sensory neurone, relay neurone, motor neurone and effector.	Explain how neurones are adapted to their function by their length, insulating sheath and branched endings (dendrites). Recall that the gap between neurones is called a synapse. Describe how an impulse triggers the release of a transmitter substance in a synapse and how it diffuses across to bind with receptor molecules in the membrane of the next neurone causing the impulse to continue.

MODULE B1: UNDERSTANDING OURSELVES

Item B1e: Drugs and You

Summary: Candidates are exposed to many influences that encourage their natural urge to experiment. This item considers the scientific knowledge and explanations of drugs, their effects and the risks involved. Many drugs are also used legitimately and some of these are considered.

This item provides the opportunity to find out about the use of contemporary scientific and technological developments in the detection and analysis of different drugs used in sport. Data from secondary sources can be collected and analysed using ICT tools. There is the opportunity to discuss how scientific knowledge and ideas change over time when investigating the link between smoking and lung cancer. Discussion of anti-smoking laws allows the development of an argument using scientific and technical terms.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Coordinate activities with other school departments. Arrange visit from the relevant police departments or rehabilitation centres.	State that drugs can be beneficial or harmful. Explain why some drugs are only available on prescription. Explain the terms addiction, withdrawal symptoms, tolerance and rehabilitation.
Research the drug testing programmes in sport.	Describe the general effects of each drug category: • depressants (slow down brain's activity); • pain killers (block nerve impulses); • stimulants (increase brain's activity and help depression); • performance enhancers (muscle development); • hallucinogens (distort what is seen and heard).
Carry out the smoking machine experiment to compare high, medium and low tar brands. Research a time line of the link between smoking and lung cancer. Discuss the current anti smoking laws.	State that tobacco smoking can cause emphysema, bronchitis, cancer (mouth, throat, oesophagus, lung and throat) and heart disease. Use information from the smoking machine experiment to show that a burning cigarette produces mainly carbon monoxide, nicotine, tars and particulates. State that a burning cigarette produces carbon monoxide and nicotine.
Produce a poster to warn drivers about the dangers of drink driving.	State that alcohol has short term effects on the brain and nervous system (impaired judgment, balance and muscle control, blurred vision, speech, vasodilation leading to heat loss and makes you sleepy) and long term effects such as liver and brain damage (dehydration of body cells). Explain why there is a legal limit for the level of alcohol in the blood/breath for drivers and pilots.

Can-Do Tasks

I can collect scientific information from a variety of sources to show the effects of drugs or smoking on the body and display or present the information. 2 points

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B1d Keeping in Touch, B6c Microorganisms – factories for the future?

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State examples of drugs that can be depressants (such as alcohol, solvents and temazepan), pain killers (such as aspirin and heroin), stimulants (such as nicotine, ecstasy and caffeine), performance enhancers (such as anabolic steroids) or hallucinogens (such as cannabis and LSD).	Explain the action of depressants and stimulants on the synapses of the nervous system.
Explain the basis of the legal classification of drugs, Class A being the most dangerous with the heaviest penalties, Class C being the least dangerous with the lightest penalties.	Discuss the consequences of the legal classification of drugs in the context of both school and national policy.
Describe the effects of: carbon monoxide (lack of oxygen, heart disease), and nicotine (addictive). Describe how cigarette smoke affects ciliated epithelial cells lining the trachea, bronchi and bronchioles and how this is linked to a 'smokers cough'. Interpret data on the effects of smoking (e.g. cancer, heart disease, emphysema and birth weights of babies born to mothers who smoke).	Describe the effects of: tars (irritant, carcinogenic); particulates (accumulation in lung tissue).
Describe how the liver can become damaged as it removes toxic alcohol (cirrhosis). Interpret data on the alcohol content (measured in units of alcohol) of different alcoholic drinks.	Interpret information on reaction times, accident statistics and alcohol levels.

MODULE B1: UNDERSTANDING OURSELVES

Item B1f: Staying in Balance

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Discuss automatic control systems in candidates' lives e.g. central heating, air conditioning, cruise control in cars, incubators.	State that the body works to maintain steady levels of temperature, water, and carbon dioxide and that this is essential to life.
Carry out an experiment on the changing skin temperature down an arm or a leg and plot the results accurately on a graph. Discuss the use of thermal blankets after such activities as marathons.	State that the temperature of the human body is normally maintained at approximately 37°C. Describe appropriate procedures to measure body temperature: • where (ear, finger, mouth, anus); • how (clinical thermometer, sensitive strips, digital recording probes, thermal imaging). Describe how heat can be gained or retained (respiration, shivering, exercise, less sweating, less blood flow near skin surface, clothing). Describe how heat can be lost (by sweating, more blood flow near skin). Recall that temperature extremes are dangerous to the body.
	Name and locate human endocrine glands and name the hormones produced: limited to pancreas (insulin); ovaries and testes (sex hormones-testosterone, oestrogen, progesterone). Apply knowledge that hormones travel in the blood to target organs to explain that body reactions to hormones are usually slower than nervous reactions. Recall that diabetes is caused by the failure of the pancreas to produce insulin.

Can-Do Tasks

I can use ICT to produce a poster warning old people about hypothermia and telling them how to prevent it. 1 point

I can carry out an experiment on skin temperatures down an arm or leg and plot the results on a graph. 2 points

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B1a Fit for Life, B3c Keep It Moving, B5e Waste Disposal, B5f Life Goes On, B6g Enzymes in Action

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain that maintaining a constant internal environment involves balancing bodily inputs and outputs and is called homeostasis. Understand that factors are kept at steady levels by automatic control systems so that cells can function at their optimum level (limited to temperature, water content and carbon dioxide).	Understand how negative feedback mechanisms are used to maintain a constant internal environment.
Describe how sweating increases heat transfer to the environment by evaporation of sweat which requires and removes heat from the skin. Describe how high temperatures can cause heat stroke and dehydration and if untreated, death. Describe how very low temperatures can cause hypothermia and if untreated, death.	Describe how vasodilation and vasoconstriction increase or reduce heat transfer to the environment. State that the body temperature of 37°C is linked to enzyme action. Explain that blood temperature is monitored by the brain which will bring about temperature control mechanisms.
Describe the effects of male and female sex hormones on secondary sexual characteristics: males – voice breaks, hair grows on face and body, more muscular body, genitals develop, sperm production; females – breast develop, hips widen, periods start, pubic hair and hair under arms grow. State that fertility in humans can be controlled by the artificial use of sex hormones: contraceptive pill; fertility drugs. Apply knowledge that insulin controls blood sugar levels and that a lack of insulin causes diabetes. Explain that diabetes can be controlled by diet or insulin dosage.	Describe how oestrogen and progesterone control the menstrual cycle; oestrogen causes the repair of the uterus wall; progesterone maintains the uterus wall; oestrogen and progesterone together control ovulation. Explain how: fertility can be reduced by the use of female hormones (contraception) which prevent ovulation by mimicking pregnancy; infertility due to lack of eggs can be treated by the use of female sex hormones. Explain how insulin helps to regulate blood sugar levels by converting excess blood glucose to glycogen in the liver. Explain that the dosage of insulin depends upon diet and activity.

MODULE B1: UNDERSTANDING OURSELVES

Item B1g: Gene Control

Summary: Recent developments in genetics have contributed to the increasing public interest in science and raised awareness of the issues involved. This item provides the necessary background to understand these issues. This item provides the opportunity to recall scientific information as a base to gaining an understanding of ethical issues.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine a model of DNA. Carry out role playing exercise to demonstrate base pairings. Research the Human Genome Project. Research the roles of Watson, Crick and others in increasing our understanding of the structure of DNA.	State that chromosomes are held in the nucleus and they carry information in the form of genes. State that the information in genes is in the form of coded instructions called the genetic code. State that the genetic code controls cell activity and consequently some characteristics of the organism. State that genes are made of a chemical called DNA. State that most body cells contain chromosomes in matching pairs.
	State that sexual reproduction is the joining of a sperm and egg to produce a new individual and half the genes come from each parent. Recall that in asexual reproduction, producing clones, all the genes come from one parent.
Can-Do Tasks There are no Can-Do tasks for this item.	

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B1h Who am I?, B2f Survival of the Fittest, B3a Molecules of Life, B3d Divide and Rule, B3f Growing Up, B3g New Genes for Old, B3h More of the Same, B5d Breath of Life, B5f Life Goes On, B6h Genetic Engineering

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that most body cells have the same number of chromosomes but this number varies between species (humans have 23 pairs).	State that DNA controls how cells function by controlling the production of proteins many of which are enzymes.
State that chromosomes are made up of long, coiled molecules of DNA divided up into regions called genes.	Understand that only some of the full set of genes are used in any one cell, some genes are switched off.
State that DNA molecules contain chemicals called bases and that there are four different bases.	State that the four bases of DNA are A, T, C and G (full names will not be required).
State that each gene contains a different sequence of bases.	
State that, at fertilisation, genetic material from both parents combines to produce the unique individual.	Explain how the random events of fertilisation produce unique individuals.
Recall that gametes have half the number of chromosomes of body cells.	

MODULE B1: UNDERSTANDING OURSELVES

Item B1h: Who am I?

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. This item provides the opportunity to show that there are some questions that science cannot address and that technology may raise ethical issues when debating arguments for and against parents knowing a baby's genetic make-up before birth.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Use poppit beads to show combinations due to chance. Toss coins to show expected and 'real' ratios. Use a genetics kit to show the results of a monohybrid cross.	Analyse human characteristics to determine those caused by the environment: • scars, spoken language. Those controlled by genes and so inherited: • earlobe shape; • eye colour; • nose shape. Those which are a result of both environmental and inherited factors: • intelligence; • body mass; • height.
	State that some disorders are inherited: red-green colour blindness, sickle cell anaemia, cystic fibrosis.
Debate the arguments for and against parents knowing a baby's gender before birth.	State that gene mutations are changes to genes.
Can Do Tasks I can use a genetics kit to show a monohybrid cross.	3 points

MODULE B1: UNDERSTANDING OURSELVES

Links to other modules: B1g Gene Control, B5h Size Matters, B6h Genetic Engineering

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Identify inherited characteristics as dominant or recessive when given the results of a breeding experiment. State that gender (in mammals) is determined by sex chromosomes: XX (female) and XY (male). Explain that genetic variation can be caused by: • mutations (changes to the genetic code); • gamete formation; • fertilisation.	Recognise that there is a debate over the relative importance of genetic and environmental factors in determining some human attributes: intelligence, sporting ability, health. Explain that dominant and recessive characteristics depend on dominant and recessive alleles: dominant alleles are those expressed in heterozygous individuals. State that alleles are different versions of the same gene. Explain a monohybrid cross involving dominant and recessive alleles: genetic diagrams using letters to represent alleles. Use and explain genetic terms: homozygous, heterozygous. Explain sex inheritance using genetic diagrams: production of equal numbers of male and female offspring.
Recall that inherited diseases are caused by faulty genes.	Explain that inherited disorders are caused by faulty alleles, most of which are recessive. Use genetic diagrams to predict the probabilities of inherited disorders passing to the next generation. Discuss the issues raised by knowledge of inherited disorders in a family.
Explain that mutations are usually harmful but may be beneficial. Mutations can be caused by radiation, chemicals, or occur spontaneously.	Explain that gene mutations change the DNA base sequence thus altering, or preventing the production of, the protein that the gene normally codes for.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2a: Ecology in our School Grounds

Summary: We are surrounded by a huge variety of living organisms, many of which go unnoticed. This item seeks to help the candidates appreciate this variety and understand the inter-relationships between them and their habitat. Candidates are introduced to methods of sampling and identifying animals and plants as well as measuring abiotic factors in the field.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Use a variety of sampling techniques e.g. pooters, nets, pit-fall traps, quadrats, tullgren funnel, belt transects.	Describe how to use collecting/counting methods: pooters, nets, pit-fall traps and quadrats.
Compare a cultivated area with an uncultivated area. Examine the variety of life in a one metre quadrat of turf or from a sample of leaf litter. Identify plants from two different habitats. Identify animals from two different habitats. Estimate the number of weeds in a field. Use sensors and data-loggers to collect data such as temperature, light intensity, soil pH; link this with the animals and plants found in different places.	Describe a method to show that a variety of plants and animals live in a small area such as a 1 m quadrat. Use simple keys to identify some plants and animals found in two different habitats. Recall and be able to apply the terms habitat and community.
Compare the communities of two different habitats.	Identify natural (woodland and lake) and artificial (greenhouse and aquarium/ fish farm) ecosystems.

Can-Do Tasks

I can use a simple key to identify some plants/animals.	1 point
I can collect data using a sampling technique.	2 points
I can investigate and compare different habitats.	3 points

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B2b Grouping Organisms

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Use data from collecting/counting methods to make quantitative estimates of population size and distribution.	Explain the limitations of counting and collecting methods: • sample size affects accuracy of estimate; • samples may be unrepresentative of population.
Use keys to identify plants and animals such as those found in pond water, lawn or leaf litter. Apply knowledge of organisms to explain why they are often restricted to certain habitats. Recall that some ecosystems, such as many ocean depths, are still unexplored, with possible undiscovered new species. Recall and use the terms ecosystem and population.	
	Describe and discuss differences between natural and artificial ecosystems (limited to biodiversity and use of weed killers, pesticides and fertilisers).

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2b: Grouping Organisms

Summary: We are surrounded by a huge variety of living organisms. Through classifying them according to their similarities and differences we can better understand their evolutionary and ecological relationships.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Identify plants from two different habitats. Identify animals from two different habitats. Place different plants and animals into groups.	Identify organisms as animals or plants.
	Identify animals as vertebrates or invertebrates. Identify vertebrates as fish, amphibians, reptiles, birds or mammals.
Research the work of John Ray and Carl Linnaeus in developing a modern classification system.	Recall that organisms of the same species have more features in common than they do with organisms of a different species.
	Recognise that sometimes organisms of the same species may show great variation: • breeds of dog.

Can-Do Tasks	
I can classify some different organisms.	1 point
I can use a simple key to identify some plants/animals.	1 point
I can present a report on the work of Carl Linnaeus.	3 points

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B2a Ecology in our School Grounds, B2e Adapt to Fit, B2f Survival of the Fittest

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the characteristics that are used to place organisms into the animal or plant kingdoms: movement, cannot make own food, more compact for movement in animals; chloroplasts, ability to make own food, more spreading in plants.	Explain why some organisms, such as fungi, are classified as neither animal or plant.
Describe the difference between vertebrates and invertebrates. Interpret characteristics to place organisms into the different classes of vertebrates: • fish – wet scales, gills; • amphibians – moist permeable skin; • reptiles – dry scales; • birds – feathers, beak; • mammals – fur, produce milk.	Discuss the problems of classification in organisms such as Euglena (plant and animal characteristics), Archaeopteryx (bird and reptile characteristics) and in newly discovered species.
Define the term species: • organisms which are of the same species are capable of interbreeding to produce fertile offspring. Use the binomial system as a basis for naming species.	Discuss the problem of classifying hybrids such as mules.
Recall that similar species tend to live in similar types of habitats. Recall that closely related species may have different features if they live in different types of habitats. Recall that similar species are closely related in evolutionary terms: • share a relatively recent ancestor.	Explain that similarities and differences between species need to be explained in terms of both evolutionary relationships and ecological relationships. Explain why dolphins and whales are classified as mammals but appear similar to fishes such as sharks.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2c: The Food Factory

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Test leaves for starch: variegated and non-variegated leaves, leaves deprived of light or carbon dioxide. Investigate the release of oxygen by pondweed.	State that plants make their own food by a process called photosynthesis. State that plants make glucose and starch by photosynthesis and release oxygen. State that plants need carbon dioxide, water, light and chlorophyll to carry out photosynthesis.
Draw a poster to show what happens to the glucose made in photosynthesis.	Explain that glucose is converted to starch and stored. Explain that glucose and starch can be converted to other substances in plants to be used for energy, growth and storage products.
Investigate the effect of changing light intensity, temperature or carbon dioxide on the rate of photosynthesis by measuring the rate of oxygen release from pondweed. Research how commercial greenhouses maximise the growth of crops by maximising the rate of photosynthesis.	Explain why plants grow faster in the summer because of more: • light; • warmth.
	State that plants carry out respiration.

Can-Do Tasks

I can measure the rate of photosynthesis by counting the rate of bubble release from pondweed.	2 points
I can test a leaf for starch.	3 points

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B1a Fit for Life, B3a Molecules of Life, B3e Growing Up, B4a Who planted that there?, B4e Energy Flow, B4f Farming, B6f Microscopic Life in Water

Assessable learning outcomes both tiers: standard demand	**Assessable learning outcomes Higher Tier only: high demand**
State the word equation to describe photosynthesis: (light energy) carbon dioxide + water → glucose + oxygen (chlorophyll)	State the balanced symbol equation for photosynthesis: (light energy) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ (chlorophyll)
Explain that the glucose made in photosynthesis is transported as soluble sugars but is stored as insoluble starch. Explain that glucose and starch can be converted to other substances in plants and used for different things: • glucose for energy (respiration); • cellulose for cell walls; • proteins for growth and repair; • starch, fats and oils for storage.	Explain why insoluble substances such as starch are used for storage.
Describe how photosynthesis can be increased by providing: • more carbon dioxide; • more light; • higher temperature.	Explain the effects of limiting factors on the rate of photosynthesis: • CO_2 • light; • temperature.
Explain why plants carry out respiration all the time.	Explain why plants take in carbon dioxide and give out oxygen during the day and do the reverse at night, in terms of both photosynthesis and respiration.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item: B2d: Compete or Die

Rationale: This item seeks to help candidates understand that there is a struggle for existence and the survival of animals and plants depends on how they cope with competition and predation. However there are also some examples of organisms co-existing to their mutual benefit.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Study a habitat and produce a display to show the most successful plants/animals competing in the habitat. For example, why are 'weeds' successful competitors?	State that animals compete for food, water, shelter and mates in order to survive and breed. Recall that plants compete for light, water and minerals. Interpret data on the distribution and population size which shows that animals and plants can be affected by competition for limited resources.
	Recognise organisms as predators or prey: • common/well known organisms; • when given details of feeding relationships.
Examine root nodules using a hand lens. Research examples of mutualism and other associations between organisms. Research how parasites are adapted to survive in or on their particular hosts.	Recognise that some organisms rely on the presence of organisms of a different species. • cleaner species e.g. oxpecker and buffalo.
Can-Do Tasks There are no Can-Do tasks for this item.	

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B2e Adapt to Fit, B2f Survival of the Fittest, B4h Recycling

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how competition may influence the distribution and population size of animals or plants, related to the availability of: food, water, shelter, light and minerals. Describe how species of organisms compete in order to survive and breed.	Explain how similar animals in the same habitat will be in close competition (e.g. different species of ladybirds, grey and red squirrel). Explain how similar organisms will compete for the same ecological niche.
Explain how the size of a predator population will affect the numbers of prey and vice versa.	Explain how the populations of predators and their prey regulate one another: • cyclic fluctuations in numbers.
Explain how the survival of some organisms may depend on the presence of another species: • parasitism where the parasite benefits to the host's detriment e.g. fleas, tapeworms; • mutualism where both species benefit e.g. cleaner species.	Explain how the interdependence of organisms determines their distribution and abundance. Explain why nitrogen-fixing bacteria in the root nodules of leguminous plants are an example of mutualism: • bacteria gain sugars; • plants gain nitrates.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2e: Adapt to Fit

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Design a predator and discuss the adaptations that will make it successful. Observe a worm using a hand lens, list all of its adaptations that make it successful for life in the soil. Make models of plants and discuss the adaptations that make it successful. Carry out an internet search to find pictures of animals with successful camouflage and other adaptations. Research organisms that have lost / reduced features that are no longer adaptations e.g. blind cave fish have lost eyes.	Recognise that animals are adapted to their habitats such as fish (water), bird (air), worm (burrowing). Recognise that plants are adapted to their habitats such as cactus (hot dry deserts), rubber plant (hot, dry conditions). Describe how some animals are adapted to be successful predators: • eyes to the front of the head to judge size and distance; • camouflage to avoid being seen by prey; • sharp teeth and claws; • built for speed. Describe how some animals are adapted to avoid being caught as prey: • eyes on side of head for wide field of view; • camouflage; • live in groups; • built for speed; • defences such as stings or poison.
Draw diagrams of animals and plants to match a written description of an imaginary environment. Discuss possible climate changes and predict which animals and plants will successfully adapt to survive in the new conditions.	Recognise that animals and plants that are adapted to their habitats are better able to compete for limited resources.

Can-Do Tasks

I can use a hand lens to observe a small animal.	1 point
I can use ICT to make a poster to explain how a camel/polar bear is adapted to its habitat.	2 points

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B1d Keeping in Touch, B2b Grouping Organisms, B2d Compete or Die, B2f Survival of the Fittest, B4b Water, water everywhere

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how a polar bear is adapted to cold arctic conditions: • thick white fur for camouflage and insulation; • layer of fat (blubber) for insulation; • sharp claws and teeth; • strong legs for running and swimming; • large size and small ears to reduce surface area (relative to size) to reduce heat losses; • large feet to spread load on snow; • fur on soles of paws for insulation and grip. Explain how a camel is adapted to dry desert conditions: • hump containing fat so it doesn't insulate whole body; • tolerance to body temperature rises so it doesn't need to sweat; • bushy eyelashes and hair-lined nostrils that can close to stop sand entering; • large feet to spread load on sand.	Explain how a cactus is adapted to hot dry conditions: • rounded shape provides a reduced surface area/volume ratio to reduce water losses; • thick cuticle reduces water losses; • leaves reduced to spines to reduce water losses and to discourage animals; • green stem for photosynthesis; • storage of water to withstand droughts; • long roots to reach water. Explain how some plants are adapted for wind pollination: • feathery stigmas; • small light pollen. Explain how some plants are adapted for insect pollination: • colourful petals; • nectar; • 'sticky' pollen.
Explain how animals and plants that are adapted to an environment are better able to compete for limited resources.	Explain how the adaptations of animals and plants determine their distribution and abundance.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2f: Survival of the Fittest

Summary: The concept of evolution is well known even though it occurs over millions of years. However, the mechanism of evolution by natural selection is commonly misunderstood. This item discusses evidence for evolution as well as its mechanism.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine fossils as evidence of organisms through time. Draw a poster to show how organisms became fossilised. Match fossils to pictures of early animals and plants. Research to find out about the different interpretations of the fossil record. Research hypotheses to explain the extinction of dinosaurs. Use a time line to show success of different vertebrate groups and the emergence of man.	State that fossils can provide evidence for living organisms from long ago. Explain that animals and plants can change over long periods of time and that fossils provide evidence for this. Describe how the relative position of fossils in rock layers can be used to show evolutionary changes during long periods of time.
Research about Lamarck and his ideas about evolution. Draw a poster to show how natural selection takes place. Design a newspaper article telling people about Charles Darwin's observations and theories. Research the role of Alfred Russell Wallace in developing the theory of natural selection. Research about Charles Darwin and his voyages. Plot the distribution of the peppered moth on a map showing major cities. Research resistant bacteria and discuss the problems they cause in hospitals. Research species that do not appear to have evolved but have stayed as they are for million of years, so called 'living fossils', e.g. coelacanth, crocodiles, sharks, and suggest why they do not appear to have changed.	Identify variations within a population of organisms of the same species. Apply knowledge that animals and plants that are better adapted to their environment are more likely to survive.

Can-Do Tasks	
I can identify a range of fossils.	1 point
I can use ICT to prepare an information leaflet explaining why the fossil record is incomplete.	2 points
I can use the internet to find out information about Charles Darwin.	1 point

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B1g Gene Control, B2b Grouping Organisms, B2d Compete or Die, B2e Adapt to Fit

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe how organisms may have become fossilised: • hard body parts (shells, bones, leaves) covered in sediment, gradual replacement by minerals; • casts / impressions; • preservation in amber, peat bogs, tar pits, ice. Explain that the fossil record is incomplete: • some body parts, particularly soft tissue, decay so do not fossilise; • fossilisation rarely occurred; • fossils not yet discovered. Interpret data on the evolution of an organism such as the horse.	Explain that the fossil record has been interpreted differently over time.
Explain that when environments change some animal and plant species survive or evolve but many become extinct. Explain that animals and plants that are better adapted to their environment are more likely to survive; this is called natural selection. Explain that adaptations are controlled by genes and that these genes can be passed on to the next generation. Describe examples of change by natural selection occurring today: • occurrence of dark or pale forms of the peppered moth in areas with different levels of pollution; • bacteria becoming resistant to antibiotics; • rats that are resistant to the rat poison warfarin.	Explain the main steps in Darwin's theory of natural selection leading to the evolution or extinction of organisms: • presence of natural variation; • competition for limited resources; • 'survival of the fittest'; • inheritance of 'successful' adaptations; • extinction of species unable to compete. Explain the reasons why the theory of evolution by natural selection met with an initially hostile response (social and historical context). Explain how Lamarck's idea of evolution by the inheritance of acquired characteristics was different from Darwin's theory and why it was discredited: • acquired characteristics do not have a genetic basis. Explain that over long periods of time the changes brought about by natural selection may result in the formation of new species.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2g: Population out of Control?

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Plot the increase in population and compare with the increase in a pollutant. Draw a poster to show the percentage of items of household waste found in the average family dustbin. Research to show the increase in levels of carbon dioxide in the past 200 years.	State that the human population is increasing. State that the human population uses finite resources: • fossil fuels; • minerals. Explain that an increasing population will increase use of resources which will lead to an increase in pollution: • household waste; • sewage; • sulfur dioxide from burning fossil fuels; • carbon dioxide from burning fossil fuels.
	Recall that pollution can affect the number and type of organisms that can survive in a particular place.

Can-Do Tasks

I can plot a population graph. 2 points

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B2h Sustainability, B4h Recycling, B6f Microscopic Life in Water

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain that as the human population increases exponentially, there is a related increase in use of resources and the production of pollution. Explain the effects of increasing amounts of pollution: • global warming from increasing levels of carbon dioxide; • ozone depletion from CFCs in upper atmosphere; • acid rain from sulfur dioxide.	Explain that the developed countries of the world, with a small proportion of the world's population have the greatest impact on the use of resources and production of pollution. Explain that the human population is increasing exponentially. Discuss the possible consequences of exponential growth.
Explain that there are indicator species whose presence/absence indicates the level of pollution. • water pollution - blood worm, waterlouse, sludgeworm, rat-tailed maggot; • air pollution – lichen. Details of particular species and pollution levels indicated not required.	Interpret data on indicator species.

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Item B2h: Sustainability

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Make a display of endangered and extinct plants and animals.	State examples of extinct animals: mammoth, dodo, sabre toothed tiger. State that an endangered species is a plant or animal in danger of becoming extinct. State examples of endangered species: panda, gorilla. State that some species in Britain are endangered and need protection: • red kite; • red squirrel; • osprey. Recognise the importance of conserving endangered species and habitats.
Web search for whale information as an example of an endangered species e.g. www.enchantedlearning.com www.clearlight.com/www.dkd.net/whales www.whalesongs.org Class discussion on 'Why save the whales?' and/or 'Why should we have zoos/marine parks?' Plot the distribution of different whale species on a world map.	Interpret data on different whale species which shows different distributions according to their feeding habitat. Consider the reasons why certain whale species are close to extinction.
	Explain the term sustainable resource. Explain that some resources can be maintained: • fish stocks; • woodland.

Can-Do Tasks

I can use the internet to collect scientific information about extinct animals. 1 point

I can use the internet to collect scientific information about various endangered species. 2 points

I can use ICT to produce an information leaflet on one endangered species, showing reasons for its predicament and suggestions for its protection. 3 points

MODULE B2: UNDERSTANDING OUR ENVIRONMENT

Links to other modules: B2g Population out of Control?

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe reasons why animals become extinct / endangered: • climate change; • habitat destruction; • hunting; • pollution; • competition. Describe how endangered species can be helped: • protecting habitats; • legal protection; • education programmes; • captive breeding programmes; • creating artificial ecosystems.	Discuss reasons for conservation programmes: • protecting human food supply; • ensuring minimal damage to food chains; • future identification of plants for medical purposes; • cultural aspects.
State that both living and dead whales have commercial value: tourism when alive; food, oil and cosmetics when dead. Consider issues arising from keeping whales in captivity: entertainment, research, captive breeding programmes and lack of freedom.	State that some aspects of whale biology are still not fully understood: communication, migration patterns and survival at extreme depths. Discuss problems of whaling: getting international agreement, policing laws and culling for research.
Explain the term sustainable development. Explain how fish stocks and woodland can be sustained and yet exploited: • education; • quotas on fishing; • re-plantation of woodland.	Discuss the importance of population size, waste products and food and energy demands to sustainable development. Recognise that sustainability requires planning and co-operation at local, national, and international levels. Describe how sustainable development may protect endangered species.

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: • the 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 Breath of 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; • the right side of the heart pumps 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, B5g New for Old.

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

Summary: 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 organisms grow by 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 for 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: 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, B1g Gene Control.

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 on a growth curve: • 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 bananas ripening 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 genes 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.

MODULE B3: LIVING AND GROWING

Links to other modules: B1g Gene Control, B3d Divide and Rule

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe in outline the cloning technique used with embryo transplants in cows: • sperm collected from selected bulls; • selected cows artificially inseminated; • embryos collected; • embryos split, forming clones; • embryo clones implanted into surrogate cows. Recall that suitable organs for transplant could be produced by cloning animals. Recognise that there are ethical dilemmas concerning human cloning.	Describe in outline the cloning technique used to produce Dolly: • nucleus removed from an egg cell; • egg cell nucleus replaced with the nucleus from an udder cell; • cell implanted into another sheep; • cell grows into a clone of the sheep from which the udder cell came. Discuss the benefits and risks of using cloning technology. Discuss the possible implications of using genetically modified animals to supply replacement organs for humans. Discuss the ethical dilemmas concerning human cloning.
Describe the advantages and disadvantages associated with the commercial use of cloned plants: • advantage: can be sure of the characteristics of the plant since all plants will be genetically identical; • advantage: it is possible to mass produce plants that may be difficult to grow from seed; • disadvantage: if plants become susceptible to disease or to change in environmental conditions then all plants will be affected; • disadvantage: lack of genetic variation.	Describe plant cloning by tissue culture: • selection for characteristics; • large number of small pieces of tissue; • aseptic technique; • use of suitable growth medium and conditions. Explain why cloning plants is easier than cloning animals: • many plant cells retain ability to differentiate unlike animal cells which usually lose this ability at an early stage.

MODULE B4: IT'S A GREEN WORLD

Item B4a: Who planted that there?

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine a variety of leaves to look at common features. Design the 'ideal' leaf. Make leaf prints and examine stomata under a microscope. Examine prepared microscope slides showing internal structure of leaves.	Identify the chloroplasts, vacuole and cell wall in a plant cell. State that chloroplasts absorb light energy for photosynthesis. State that photosynthesis occurs mainly in the leaves. Describe the entry points of materials required for photosynthesis: • water through roots; • carbon dioxide through leaf pores. Describe the exit point of materials produced in photosynthesis: • oxygen through leaf pores.

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B2c The Food Factory, B3b Diffusion, B3e Growing Up, B4b Water, water everywhere, B4e Energy Flow, B6a Understanding Bacteria

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Name and locate the parts of a leaf: • cuticle; • upper and lower epidermis; • palisade and spongy mesophyll layers; • stomata and guard cells; • veins. Explain how leaves are adapted for efficient photosynthesis: • broad so large surface area; • thin so short distance for gases to travel; • contain chlorophyll to absorb light; • have a network of veins for support and transport; • stomata for gas exchange. State that the exchange of gases is by diffusion. Explain how the structure of a leaf palisade cell is related to its function: • contains many chloroplasts.	Explain how the cellular structure of a leaf is adapted for efficient photosynthesis: • epidermis is transparent; • palisade layer at the top containing most of the chloroplasts; • air spaces in the spongy mesophyll allow diffusion between stomata and photosynthesising cells; • internal surface area / volume ratio very large.

MODULE B4: IT'S A GREEN WORLD

Item B4b: Water, water everywhere

Summary: Water is important for all living things and plants are no exception. Water is needed for key life processes such as photosynthesis, support and transport of materials. Water enters plants by osmosis and leaves by transpiration. The investigations each provide the opportunity to plan to test a scientific idea, analyse and interpret data using qualitative and quantitative techniques, present information and draw a conclusion using scientific and technical conventions.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out experiments to demonstrate osmosis using visking tubing and different concentration solutions.	State that water moves in and out of plant cells through the cell wall and membrane.
Investigate the effects of changing solute concentration on potato discs/strips.	State that the plant cell wall provides support. State that lack of water can cause plants to droop (wilt).
Investigate how quickly detached leaves dry out when different surfaces are covered with petroleum jelly.	Describe how water travels through a plant: • absorption from soil through root hairs; • transport through the plant to the leaves; • evaporation from the leaves (transpiration).
Make leaf prints of upper and lower surfaces of leaves and examine with microscope to investigate number / distribution of stomata.	Explain that healthy plants must balance water loss with water uptake.

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B2e Adapt to Fit, B3b Diffusion, B3e Growing Up, B4a Who planted that there?, B4c Transport in Plants, B6f Microscope Life in Water.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe osmosis as the movement of water across a partially-permeable membrane from an area of high water concentration (i.e. dilute solution) to an area of low water concentration (i.e. concentrated solution). State that osmosis is a type of diffusion. Explain the term partially-permeable.	Explain that osmosis is the net movement of water molecules from an area of high water concentration to an area of low water concentration across a partially-permeable membrane and is a consequence of the random movement of individual particles. Predict the direction of water movement in osmosis.
State that the both the inelastic cell wall and water are essential for the support of plants.	Explain how plants are supported by the turgor pressure within cells: • water pressure acting against inelastic cell wall. Explain wilting in terms of a lack of turgor pressure. Explain the terms: flaccid, plasmolysed, turgid.
Explain that root hairs, by increasing surface area increase the ability of roots to take up water by osmosis. State that transpiration provides plants with water for: • cooling; • photosynthesis; • support; • movement of minerals. Explain the loss of water from leaves in terms of the diffusion of water molecules.	Explain that transpiration and water loss from leaves are a consequence of the way in which leaves are adapted for efficient photosynthesis.
Describe how the structure of a leaf is adapted to reduce excessive water loss: • waxy cuticle; • small number of stomata on upper surface.	Explain how the cellular structure of a leaf is adapted to reduce water loss: • changes in guard cell turgidity (due to light intensity and availability of water) to regulate stomatal apertures; • number, distribution, position and size of stomata.
Describe the effects of the uptake and loss of water on animal cells.	Explain how the differences in the effects of water uptake and loss on plant and animal cells depend on the presence/absence of an inelastic cell wall. Use the terms: crenation and lysis.

MODULE B4: IT'S A GREEN WORLD

Item B4c: Transport in plants

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine stained cells in celery left in ink.	Relate plant structure to function: • stem - support, transport; • leaf – photosynthesis; • flower – reproduction; • root - water and mineral uptake and anchorage.
Carry out experiments to show transpiration: • loss of water by plants; • plants lose water through their leaves; • which surface of a leaf loses most water; • weighing potted plants- loss of mass.	State that water travels up plant stems.
Carry out an experiment to show factors that affect transpiration rate: • light; • wind; • temperature; • humidity. ICT data logging opportunity.	Describe experiments to show that transpiration rate is affected by: • light intensity; • temperature; • air movement; • humidity.

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B4b Water, water everywhere, B4d Plants need minerals too

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the arrangement of xylem and phloem in a dicotyledonous root, stem and leaf: • vascular bundles. Relate xylem and phloem to their function: • xylem - transpiration - movement of water and minerals from the roots to the shoot and leaves; • phloem - translocation - movement of food substances (sugars) up and down stems to growing and storage tissues. State that both xylem and phloem form continuous systems in leaves, stems and roots.	Describe the structure of xylem and phloem: • xylem vessels - thick strengthened cellulose cell wall with a hollow lumen (dead cells); • phloem – columns of living cells.
Describe how transpiration helps cause water to be moved up xylem vessels. State that transpiration is the evaporation and diffusion of water from inside leaves.	
Describe how transpiration rate is increased by: • increase in light intensity; • increase in temperature; • increase in air movement; • decrease in humidity.	Explain why transpiration rate is increased by: • increase in light intensity; • increase in temperature; • increase in air movement; • decrease in humidity.

MODULE B4: IT'S A GREEN WORLD

Item B4d: Plants need minerals too

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey the contents of fertilisers such as 'plant foods'.	State that fertilisers contain minerals such as nitrates, phosphates, potassium and magnesium compounds and that these are needed for plant growth. Interpret data on NPK values to show the relative proportions of nitrates, phosphates and potassium in fertilisers.
Carry out an experiment to show the results of mineral deficiencies in plants. Investigate fertilisers.	State that poor plant growth may be caused by a lack of one or more minerals in the soil.
	Recall that dissolved minerals are absorbed by the roots from the soil.

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B1a Fit for Life, B3a Molecules of Life, B4c Transport in plants, B4f Farming, B4h Recycling, C4c Fertilisers and crop yield

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

MODULE B4: IT'S A GREEN WORLD

Item B4e: Energy Flow

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Construct a mobile to illustrate trophic levels.	Explain the terms producer and consumer.
Survey peers on vegetarian diet.	State that energy enters food chains when plants absorb sunlight.
	State that plants produce biomass when they photosynthesise. Recall examples of fuels from biomass: • wood; • alcohol; • biogas.

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B2c The Food Factory, B4a Who planted that there?, B4f Farming, P3e Energy on the Move, B6d Biofuels, B6f Microscopic Life in Water

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Construct pyramids of numbers from given information and explain what they show: • the numbers of organisms at each stage of a food chain. Construct pyramids of biomass from given information and explain what they show: • the mass of living material at each stage of a food web or chain. Distinguish between pyramids of numbers and pyramids of biomass.	
Explain that energy from the sun flows through food chains by photosynthesis and feeding. Interpret data on energy flow in food chains and webs. Explain how some energy is transferred to less useful forms at each stage (trophic level) in the food chain: • heat from respiration; • egestion.	Explain how the efficiency of energy transfer explains the shape of pyramids of biomass. Explain how the efficiency of energy transfer explains the limited length of food chains. Calculate the efficiency of energy transfer.
Describe different methods of transferring energy from biomass: • burning fast growing trees; • fermenting biomass using bacteria or yeast.	Explain reasons for developing biofuels: • renewable; • reduces air pollution; • energy self-reliance. Discuss choice of use of biomass to include: • eating it; • feeding it to livestock; • using it as a fuel; • growing the seeds.

MODULE B4: IT'S A GREEN WORLD

Item B4f: Farming

Summary: Organic farming has become more widespread but intensive farming techniques are more common. This item looks at the issues concerning organic and intensive farming. Discussing different farming methods provides many opportunities to investigate why decisions about science and technology are made and the ethical issues raised. This can be developed to look at the social, economic and environmental effects of such decisions and highlights that there are some questions science cannot address.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Arrange visit to a local farm / garden centre / small holding.	Analyse data to show that farmers can produce more food if they use herbicides and pesticides and other intensive practices, but that these practices can cause harm to the environment and to health. State that: • pesticides kill pests; • herbicides kill plants (weeds). State that examples of pesticides include: • insecticides to kill insects; • fungicides to kill fungi.
Role play exercise to highlight different view points on intensive farming.	Describe how intensive farming methods can increase productivity: • fish farming; • glasshouses; • hydroponics; • battery farming.
Survey use of organic food and reasons for choice. Grow lettuce / tomato plants using hydroponics. Investigate web sites such as DEFRA, LEAF.	Describe organic farming methods: • no artificial fertilisers; • no herbicides; • no pesticides.
	Describe how pests can be controlled biologically by introducing predators.

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B2c The Food Factory, B4d Plants need minerals too, B4e Energy Flow, B6e Life in Soil, B6f Microscopic Life in Water

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain that intensive farming means trying to produce as much food as possible from the land, plants and animals available. Explain that intensive farming methods may be efficient but they raise ethical dilemmas. Describe how intensive farming produces more food but: • pesticides may enter and accumulate in food chains; • pesticides may harm organisms which are not pests.	Explain how intensive food production improves the efficiency of energy transfer by reducing energy transfer: • to competing plants; • to pests; • as heat from farm animals by keeping them penned indoors (battery farming) – warm and less movement. Explain why pesticides may accumulate in food chains.
Describe how plants can be grown without soil (hydroponics). Describe possible uses of hydroponics: • glasshouse tomatoes; • plant growth in areas of barren soil.	Explain the advantages and disadvantages of hydroponics: • better control of mineral levels; • better control of disease; • lack of support for plant; • required addition of fertilisers.
Describe organic farming techniques: • use of animal manure and compost; • crop rotation; • use of nitrogen-fixing crops; • weeding; • varying seed planting times.	Discuss the advantages and disadvantages of organic farming techniques.
Explain the advantages and disadvantages of biological control. Explain how removing one organism from a food chain or web may affect other organisms.	

MODULE B4: IT'S A GREEN WORLD

Item B4g: Decay

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

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

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B4h Recycling, B6a Understanding Bacteria, B6d Biofuels

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the effects on the rate of decay of changing: • temperature; • amount of oxygen; • amount of water.	Explain the effects of changing temperature, and the amounts of oxygen and water on the rate of decay: • effect on microbial respiration; • effect on growth and reproduction of micro-organisms.
State that detritivores feed on dead and decaying material (detritus): • earthworms, maggots, woodlice. Explain how detritivores increase the rate of decay: • produce larger surface area.	Explain the term saprophyte. Explain how decay involves saprophytic nutrition by bacteria and fungi.
Explain how food preservation methods reduce the rate of decay: • canning; • cooling; • freezing; • drying; • adding salt / sugar; • adding vinegar.	

MODULE B4: IT'S A GREEN WORLD

Item B4h: Recycling

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey of local recycling schemes.	State that as animals and plants grow they take in chemicals and incorporate elements from these into their bodies. State that when animals and plants die and decay these elements are recycled. State that elements that are recycled include: • carbon; • nitrogen.
Carry out an experiment to test soil for nitrogen. Examine clover roots to see nodules.	

MODULE B4: IT'S A GREEN WORLD

Links to other modules: B1a Fit for Life, B2d Compete or Die, B2g Population out of Control, B4d Plants need minerals too, B4g Decay, B6e Life in Soil

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how carbon is recycled in nature: • plants remove carbon dioxide from the air by photosynthesis; • feeding passes carbon compounds along a food chain or web; • plants and animals release carbon dioxide into the air, as a product of respiration; • soil bacteria and fungi, acting as decomposers, release carbon dioxide into the air; • burning of fossil fuels (combustion) releases carbon dioxide.	Explain that soil bacteria and fungi, acting as decomposers, release carbon dioxide into the air by respiration. Explain how carbon is recycled in the sea: • marine organism make shells made of carbonates; • shells become limestone; • carbon returns to air as carbon dioxide during volcanic eruption or weathering.
Explain how nitrogen is recycled in nature: • plants take in nitrates from the soil to make protein for growth; • feeding passes nitrogen compounds along a food chain or web; • nitrogen compounds in dead plants and animals are broken down by decomposers into nitrates and returned to the soil. State the abundance of nitrogen in the air (78%). Explain that nitrogen gas can't be used directly by animals or plants because it is too unreactive.	Explain how nitrogen is recycled in nature: • soil bacteria and fungi, acting as decomposers, convert proteins and urea into ammonia; • the conversion of this ammonia to nitrates by nitrifying bacteria; • the conversion of nitrates to nitrogen gas by denitrifying bacteria; • the fixing of nitrogen gas by nitrogen-fixing bacteria living in root nodules or the soil or by the action of lightning.

MODULE B5: THE LIVING BODY

Item B5a: In good shape

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

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

Can-Do Tasks	
I can identify a fracture from an X-ray.	1 point
I can identify the main bones and muscles in an arm.	2 points

MODULE B5: THE LIVING BODY

Links to other modules: B5g New for Old

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

MODULE B5: THE LIVING BODY

Item B5b: The vital pump

Summary: Our heart beats automatically from before birth until we die; it also adjusts itself to varying levels of activity. The history of discoveries about blood circulation is an interesting story culminating in our increasing use of modern technology.

Using video clips to show heart action is an example of using ICT in teaching and learning while ECG traces illustrate the use of ICT in science.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Listen/watch Tony Hancock's classic "The blood donor".	State that: • some animals (such as Amoeba) do not have a blood circulatory system; • some animals (such as insects) have an open circulatory system; • some animals (such as humans) have a closed circulatory system. State that in a closed circulatory system blood will flow in arteries, veins and capillaries.
Watch video/flash clips on heart action.	
Interpret ECG trace of a normal beat (PQRS wave).	Describe the heart as made of powerful muscles which are supplied with food and oxygen by the coronary artery. State that the pulse is a measure of the heart beat (muscle contraction) to put the blood under pressure and that it can be detected at various places (wrist, ear, temple). Describe how to measure pulse rate.

Can-Do Tasks

I can construct a time line of discoveries about blood circulation using various sources.	2 points
I can display information using charts and graphs about heart disease in the world.	2 points

MODULE B5: THE LIVING BODY

Links to other modules: B3c Keep it Moving, B5c Running Repairs, B5g New for Old.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe a single circulatory system as being one circuit from the heart. Describe a double circulatory system as being two circuits from the heart. Interpret data on blood volume to different body organs.	Describe the contribution of William Harvey and Galen towards the understanding of blood circulation. Understand what is meant by a single circulatory system and links to a two chambered heart. Understand what is meant by a double circulatory system and links to a four chambered heart.
Identify the four chambers (atria, ventricles) of the heart and associated main blood vessels (aorta, vena cava, pulmonary artery and vein). Interpret data on pressure changes in arteries, veins and capillaries.	Describe the cardiac cycle and interpret associated graphs and charts.
Describe how heart rate is linked to activity. State that heart muscle contraction is controlled by groups of cells called the pacemaker and that these cells produce a small electric current. State that artificial pacemakers are now commonly used to control heart beat. State that techniques such as ECG and echocardiograms are used to investigate heart action.	Describe how the pacemaker cells (SAN and AVN) coordinate heart muscle contraction. Interpret data from ECG and echocardiograms. Understand that alterations in heart rate are also brought about by hormones such as adrenaline.

MODULE B5: THE LIVING BODY

Item B5c: Running Repairs

Summary: Our heart and circulation can go wrong. We need to understand how our lifestyle can cause this. We also need to know how these faults can be detected and how they can be put right using modern surgical techniques. This item allows discussion on some of the decisions and ethical issues around blood donation. The topic of haemophilia illustrates 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
Examine models of heart and heart valves. Watch videos/ flash clips to show action of valves. Research types of heart valves.	State that there are many heart conditions and diseases such as: • irregular heart beat; • hole in the heart; • damaged or weak valves; • coronary heart disease and heart attacks.
Examine blood slides under the microscope.	Identify parts of the blood (red blood cells, white blood cells, plasma and platelets).
Carry out an investigation to see how many people carry donor cards. Research the incidence of haemophilia in Europe's royal families. Visit or listen to a presentation from the National Blood Service.	Describe reasons for blood donation and why some people carry donor cards. State that there are different blood groups called A, B, AB and O, which are further subdivided into Rhesus positive and negative. State that blood clots normally at cuts and sometimes abnormally inside blood vessels. State that anti-coagulant drugs can be used to reduce clotting.
Can-Do Tasks There are no Can-Do tasks for this item.	

MODULE B5: THE LIVING BODY

Links to other modules: B3c Keep it Moving, B5b Vital Pump, B5g New for Old.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Compare normal blood circulation to that resulting from a hole in the heart and recall that such a condition can be corrected by surgery. Describe the effects of damaged or weak valves on blood circulation and recall they can be replaced by artificial valves. Describe the effects of a blocked coronary artery and recall that the standard treatment is bypass surgery. State that there are "heart assist" devices as well as heart transplants. Discuss advantages and disadvantages of heart transplants.	Describe how lifestyle can affect the circulatory system to include: • diet; • alcohol; • smoking; • stress; • drugs. Interpret data on heart diseases.
Describe the functions of the blood components (to include haemoglobin in red blood cells).	Relate the structure of blood components to their functions.
Discuss whether the carrying of donor cards should be made compulsory. Describe the process of blood donation and blood transfusion. State that haemophilia is an inherited condition in which the blood does not easily clot. State that substances such as Vitamin K, alcohol, green vegetables and cranberries affect clotting. State that drugs such as warfarin, heparin and aspirin are used to control clotting.	Describe how the presence of agglutinins in red blood cells and blood serum determines how blood groups react and therefore blood donation. Interpret data on blood groups and possible donors and recipients. Describe, in outline only, the process of blood clotting.

MODULE B5: THE LIVING BODY

Item B5d: Breath of Life

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment to show that respiration of peas releases heat energy. Carry out an experiment to show the different amounts of carbon dioxide in inhaled and exhaled air.	State that all living things respire to get oxygen to release energy from food. State that small simple organisms such as Amoeba and earthworms take in oxygen through their skin which must be moist. State that larger, more complex animals have special organs such as gills and lungs.
Examine a model of a bell jar and rubber sheet to explain breathing. Measure lung capacities.	Identify the main parts of the human respiratory system (trachea, bronchus, bronchioles, lungs, air sacs, pleural membranes, ribs, intercostal, muscles and diaphragm). Understand the terms, breathing, respiration, inspiration and expiration.
Carry out an experiment to test peak flow of individuals.	Recall that there are many conditions and diseases (such as asthma, bronchitis, pneumonia and lung cancer) of the respiratory system.

Can-Do Tasks

I can measure my peak flow.	1 point
I can carry out an experiment to show the differing amounts of carbon dioxide in inhaled and exhaled air.	2 points
I can survey one industrial disease and present the information in a poster or leaflet.	2 points

MODULE B5: THE LIVING BODY

Links to other modules: B1g Gene Control, B3b Diffusion

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain how the methods of gaseous exchange of amphibians and fish restrict them to their habitats.	Describe how the structure of a fish gill allows efficient gaseous exchange in water.
Understand the terms tidal air, vital capacity air and residual air as part of the total lung capacity. Describe how efficient intake and output of air uses the intercostal muscles and diaphragm to change volume and pressure inside the chest.	Describe how the structure of the respiratory system is linked to efficient diffusion of oxygen and carbon dioxide: • large surface area of alveoli; • moist surface; • thin lining; • good blood supply. Interpret data on lung capacities (from a spirometer).
Describe how the respiratory system protects itself from disease by mucous and ciliated cells in the trachea and bronchi. Understand that there are lung diseases: • (such as asbestosis) called industrial diseases; • (such as cystic fibrosis) with genetic causes; • (such as lung cancer) caused by life style, smoking. and briefly describe each disease. Describe symptoms and treatment of asthma.	Understand that the respiratory system is prone to diseases since the lungs are “a dead end”. Explain what happens during an asthma attack. Interpret data on respiratory diseases.

MODULE B5: THE LIVING BODY

Item B5e: Waste Disposal

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out experiments to test mock urine samples. Research methods of artificial respiration. Research kidney failure and its treatment.	Describe the difference between getting rid of solid waste through the anus (defecation) and getting rid of waste produced by the body (excretion). Name and locate position of the main organs of excretion: • lungs; • kidneys; • liver; • skin. State that the kidneys excrete urea, water and salt. State that carbon dioxide is produced by respiration, and is removed from the body through the lungs.
	Identify the basic parts of the skin (epidermis, dermis, hair follicle, sweat gland). State that the skin excretes sweat containing water and salt.

Can-Do Tasks

I can investigate urine samples and correctly identify them.	2 points
I can perform rescue breaths using a model.	2 points

MODULE B5: THE LIVING BODY

Links to other modules: B1f Staying in Balance, B5g New for Old.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the gross structure of a kidney and associated blood vessels. Explain how kidneys work: • filter blood at high pressure; • re-absorb water and useful substances. State that urea, produced in the liver (from excess amino acids) is removed by the kidneys. Describe how the amount of urine produced is affected by water intake, heat and exercise. Explain that high levels of carbon dioxide must be removed from the body.	Explain how the structure of the kidney tubule is related to filtration of the blood and formation of urine, including: • a filter unit of glomerulus and capsule; • a region for selective reabsorption; • a region for salt and water regulation. Explain the principle of a dialysis machine and how in a patient with kidney failure it removes urea and maintains levels of sodium and glucose in the blood. Explain how the concentration of urine is controlled by the anti-diuretic hormone (ADH), produced by the pituitary gland. Understand how ADH production is controlled by a negative feedback mechanism. Explain that when increased carbon dioxide levels in the blood are detected by the brain an increased rate of breathing results.
Describe how the sweat evaporates, thus cooling down the skin.	

MODULE B5: THE LIVING BODY

Item B5f: Life Goes On

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine microscope slides of teste's and ovary. Examine models of developing foetus.	State that fertilisation is the result of fusion between a male gamete (sperm) and a female gamete (egg). State the basic structure of male reproductive system (testes to produce sperm, sperm ducts, scrotum, penis). State the basic structure of the female reproductive system (ovaries to produce eggs, oviduct, uterus, vagina).
Role play or debate about using infertility treatments.	State that fertilisation and pregnancy are not guaranteed for all couples.

Can-Do Tasks

There are no Can-Do tasks for this section.

MODULE B5: THE LIVING BODY

Links to other modules: B1g Gene Control, B1f Staying in Balance.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the main stages of the menstrual cycle and the reasons for such changes.	Understand the control of the menstrual cycle by the hormones oestrogen, progesterone, FSH and LH.
Describe treatments for infertility to include: • artificial insemination; • use of FSH; • "in vitro" fertilisation (IVF); • egg donation; • surrogacy; • ovary transplants.	Discuss the arguments for and against such infertility treatments.
Describe foetal investigations such as amniocentesis to identify conditions such as Down's syndrome.	Discuss the ethical issues raised by foetal screening.

MODULE B5: THE LIVING BODY

Item B5g: New for Old

Summary: With people living longer, parts of their bodies are wearing out or going wrong. This item encourages discussion about possible treatments and ethical issues involved. It also provides the opportunity to debate the issues.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Research donor cards and other donor organisations such as the Anthony Nolan Trust.	State the variety of body parts which can be mechanically replaced limited to: • kidney; • knee and hip joints; • heart; • lens of eye. State the variety of body parts that can be biologically replaced limited to: • blood; • cornea; • heart, • lungs, • kidney and bone marrow.
Research the history of one organ transplant.	Know that organs that can be donated by living or dead donors.
Can-Do Tasks There are no Can-Do tasks for this item.	

MODULE B5: THE LIVING BODY

Links to other modules: B3c Keep it Moving, B5a In Good Shape, B5b The Vital Pump, B5c Running Repairs, B5e Waste Disposal

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State problems in supply of donor organs limited to: • shortage of donors; • tissue match; • size and age. Describe problems of using mechanical replacements limited to: • size; • power supply; • materials used • body reactions State that some mechanical replacements such as the heart and lung machine, kidney dialysis and iron lung are used outside the body.	Discuss the ethical issues concerning organ donation. Describe problems with transplants limited to: • rejection; • immuno-suppressive drug treatment.
Explain why donors can be living and what makes a suitable living donor. State the criteria needed for a dead person to be a suitable donor.	Discuss the idea of a register of donors. Interpret data on transplants and success rates.

MODULE B5: THE LIVING BODY

Item B5h: Size matters

Summary: We start life as a microscopic fertilised egg and grow at different rates at different times of our lives and are sometimes surprised to find we have reached a height of nearly two metres.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
	State that animals grow in early stages in their lives whereas plants grow continually. State that all parts of an animal are involved in growth whereas plants grow at special areas called meristems. State that new cells for growth are produced by a type of cell division called mitosis.
Measure heights of candidates in your class/year and display as normal distributions for boys and girls. Collect data from another year group and compare distributions. Use web sites/ visit museums/ use reference books to find out average heights during history (look at suits of armour, door heights in old buildings, height requirements for the Armed Forces).	State that growth can be measured as an increase in height or mass. State that a person's final height and mass is determined by: • their genes; • diet and exercise; • hormones; • health/disease. Interpret data on human growth. State that a human progresses gradually from • infancy (up to 2 years); • childhood (from 2 to 11 years); • puberty (from 11 to 13/15 years); • adulthood (the longest stage); • old age (above 60/65 years).

Can-Do Tasks

I can collect and display data to show height distributions in candidates. 2 points

MODULE B5: THE LIVING BODY

Links to other modules: B1h Who am I?, B3d Divide and rule, B1b What's for Lunch?, B3e Growing Up.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that mitosis produces identical cells.	
Understand that extremes in height (dwarfs and giants) are usually caused by their genes or hormone imbalance. Describe how diet and exercise can influence growth. State that babies' length, mass and head size are regularly monitored during their first months. State that these measurements are plotted on average growth charts to highlight any growth problems. State that life expectancy has greatly increased during recent times and suggest possible causes (such as less industrial disease, healthier diet and life style, modern treatments and cures for disease, better housing).	State that the human growth hormone is produced by the pituitary gland and that it stimulates general growth especially in long bones. Interpret data on human growth charts. Understand that average growth charts are simply a guide to show a comparison. Discuss possible problems of more people living longer on a personal and national level.

MODULE B6: BEYOND THE MICROSCOPE

Item B6a: Understanding bacteria

Summary: We are used to talking about plants and animals that can be seen and touched. Microscopic organisms such as bacteria tend to be either ignored or cause fear. Yet many things we take for granted are controlled by bacteria. Practical work with microorganisms develops the skills of working safely and accurately.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine greatly magnified images of bacteria. Calculate magnification. 'How big would a cat be if we magnified it by the same factor?' is a useful problem to solve.	Recognise that bacterial cells are smaller and simpler than plant and animal cells. Know that the size of a typical bacterial cell is just a few microns (thousandths of a mm). Be able to label the following parts of a flagellate bacillus as shown by E. coli: • flagellum; • cell wall; • bacterial DNA. State that bacteria can be classified by their shape.
	State that bacteria reproduce by splitting into two.
Make yoghurt using freshly pasteurised milk and a starter culture of live yoghurt.	State that some bacteria are useful in: • yoghurt making; • cheese production; • vinegar production; • silage production; • composting.

Can-Do Tasks

I can follow instructions to produce a sample of yoghurt. 2 points

I can measure / record the pH of milk as it is converted to yoghurt using pH paper / pH meter / data logger. 2 points

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B1c Keeping Healthy, B3a Molecules of Life, B3e Growing Up, B4a Who planted that there?, B4g Decay, B6b Harmful Microorganisms

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State the function of the parts of a bacterial cell: • flagellum for movement; • cell wall to maintain shape, and to stop it from bursting; • bacterial DNA to control the cell's activities and replication of the cell. Identify simple differences between bacterial cells and plant and animal cells. State that bacterial cells lack: • a 'true' nucleus; • mitochondria; • chloroplasts; • vacuole. Describe the main shapes of bacteria as: • spherical; • rod; • spiral, • curved rods.	Recognise that since some bacteria can consume organic nutrients and others can make their own, this means that: • they can survive on an enormous range of energy sources; • they can exploit a very wide range of habitats.
State that bacteria reproduce by a type of asexual reproduction called binary fission and that they can be grown in large fermenters.	Recognise the consequences of very rapid reproduction in terms of food spoilage and disease.
Describe the main stages in making yoghurt including: • sterilisation of equipment; • pasteurisation of milk; • incubation of culture; • sampling; • addition of flavours, colours then packaging.	Explain reasons for the safe handling of bacteria.

MODULE B6: BEYOND THE MICROSCOPE

Item B6b: Harmful microorganisms

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Research incidence of disease following a recent natural disaster. Research how aid agencies such as the Red Cross respond rapidly to an emergency. Grow bacteria on agar dishes using appropriate aseptic techniques. Testing antiseptics/antibodies on agar cultures.	Describe how disease causing organisms can enter the body, limited to: • nose (airborne microorganisms); • mouth (contaminated food and water); • skin (insect bites, cuts, infected needles); • reproductive organs (contact). Relate different types of microorganisms to the disease they can cause: • tuberculosis, food poisoning, septic wounds caused by bacteria; • influenza, chickenpox, smallpox caused by viruses; • athlete's foot caused by fungi; • malaria, dysentery caused by protozoa.
	Recall that natural disasters such as earthquakes and erupting volcanoes can cause the rapid spread of disease.
	Recall that harmful bacteria can be controlled by antibiotics.

Can-Do Tasks

I can prepare a culture of bacteria on an agar plate using aseptic technique. 3 points

I can compare the effectiveness of different antiseptics using a culture of bacteria on an agar plate (by measuring and comparing the diameters of the halos). 3 points

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B1c Keeping Healthy B6a Understanding Bacteria.

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall that some bacteria are pathogens (disease causing). Describe the cause and transmission of: • food poisoning (bacteria); • cholera (bacteria); • dysentery (by a protozoan); • influenza (by a virus). Describe the stages in an infectious disease, to include: • entry into the body; • rapid growth, the incubation period; • production of many toxins; • appearance of symptoms such as fever.	Recall the organisms involved in: • food poisoning (Salmonella, E.coli); • cholera (Vibrio); • dysentery (Entamoeba). Interpret data on the incidence of food poisoning, cholera, dysentery and septicaemia.
Recall that diseases such as dysentery, cholera and food poisoning can be a major problem following a natural disaster.	Describe how natural disasters cause a rapid spread of diseases: • damaged sewage systems and water supplies; • damaged electrical supplies causing rapid food decay; • disrupted health services.
Describe the pioneering work of the following scientists in the treatment of disease: • Pasteur and the germ theory of disease; • Lister and the development of antiseptics; • Fleming and the discovery of penicillin. Describe how antiseptics and antibiotics can be used in the control of disease.	

MODULE B6: BEYOND THE MICROSCOPE

Item B6c: Microorganisms –factories for the future?

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
	State that fermentation is the breakdown of sugars by yeast in the absence of oxygen.
Make a slide of yeast and stain it with methylene blue and examine it under a microscope.	State that yeast is a fungus and that it can be easily stored in a dry condition. Identify and label parts of a yeast cell (nucleus, cytoplasm, wall, bud). State that yeast reproduces asexually by budding.
Brewing beer, cider or wine. A 'home brew' beer or wine kit can be used to demonstrate the principles of fermentation.	State some of the drinks produced by fermentation and the source from which they are made, limited to: • wine from grapes; • beer from malted barley; • cider from apples. State that a gas, CO_2, is also produced during fermentation.
	Recall that some products of fermentation can be further treated to increase the alcohol concentration to produce spirits.

Can-Do Tasks	
I can collect gas from fermenting sugar and test it for carbon dioxide.	1 point
I can make a slide of yeast cells, stain it and make a labelled drawing.	3 points
I can do an experiment to show how yeast activity is affected by temperature.	3 points

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B1e Drugs and You. C6c Alcohols, B1a Fit for Life

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State the word equation for fermentation (anaerobic respiration in yeast).	State the balanced chemical equation for fermentation (anaerobic respiration).
Recognise that yeast can reproduce at a fast rate, its optimum growth rate being controlled by: • food availability; • temperature; • pH; • and removal of products. State that yeast can be used to deal with water contaminated by sugars from food processing factories.	State that yeast growth rate doubles for every 10°C rise in temperature. Recognise that yeast can undergo aerobic or anaerobic respiration and the implications of this to the fermentation process. Interpret data on breakdown of sugar by yeast in different conditions such as changing temperature, presence or absence of oxygen.
Describe the main stages in brewing beer or wine to include: • extracting sugar from source material; • adding hops for beer flavouring; • adding yeast, keeping it warm; • preventing entry of air and other micro-organisms; • clarifying/clearing drawing off the wine/beer; • pasteurising, casking or bottling.	State what is meant by the term pasteurisation and understand why this needs to be done in the case of bottled beers.
Recall the sources of spirits limited to: • rum from cane sugar; • whisky from malted barley; • vodka from potatoes. Describe the process of distillation to increase the alcoholic concentration, and understand that this commercial process needs licensed premises.	Recognise that fermentation is limited by the increasing level of alcohol eventually killing the yeast. State that different strains of yeast can tolerate different levels of alcohol.

MODULE B6: BEYOND THE MICROSCOPE

Item B6d: Biofuels

Summary: With problems of declining stocks of fossil fuels and long term problems of nuclear energy, many countries are developing cleaner fuels which only need simple technology.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Research the use of biogas in Nepal.	State that rotting organic material such as dead plants and animal waste produces methane. State that rotting is caused by the action of bacteria. State that biogas is a mixture of gases and can be produced on a large scale using a digester.
Design a biogas digester. Research use of biogas in cities such as Newcastle and Leeds.	State that biogas is used in certain remote parts of the world lacking a mains electricity supply or mains sewage system. Describe the dangers of methane being released from landfill sites (it can burn or explode preventing use of the site for many years).
	State that alcohol, made from yeast, can be used as a clean biofuel e.g. as gasohol (ethanol/petrol mixture) for cars in countries such as Brazil.
Can-Do Tasks I can design a biogas digester and display the plans as a chart.	3 points

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B4g Decay, B4e Energy Flow

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that marshes, septic tanks and animal digestive systems produce a mixture of gases called biogas. Recall that biogas contains: • mainly methane; • some carbon dioxide; • traces of hydrogen, nitrogen and hydrogen sulphide.	Recognise that biogas containing more than 50% methane burns easily and that a lower percentage of about 10% is explosive. Describe how different types of bacteria are needed to break down organic material.
Describe the uses of biogas such as: • burned to generate electricity; • burned to produce hot water and steam for central heating systems; • used as a fuel for buses. Describe how methane can be produced on a large scale using a continuous flow method of providing organic waste and removing the gas and remaining solids. Describe how biogas production is affected by temperature.	Recognise that biogas is a cleaner fuel than diesel and petrol but does not contain as much energy as natural gas. Explain why biogas production is affected by temperature.
Describe the advantages of using biofuels such as: • alternative source to fossil fuels; • less carbon dioxide produced than in fossil fuels; • no particulates produced.	Explain the advantages of producing and using biofuels instead of fossil fuels in terms of: • effects on greenhouse gases; • conservation of resources; • sustainability.

MODULE B6: BEYOND THE MICROSCOPE

Item B6e: Life in soil

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Identify soil fauna and flora using identification keys. Examine microscopic soil life using light and binocular microscopes. Investigate the humus, air, water content of soil.	Describe the main components of soil as being rock particles, humus (dead material), living organisms, air and water. State that the majority of plants rely on soil for: • anchorage; • source of minerals; • water. State that soil contains: • fungi; • microscopic protozoans; • nematode worms; • earthworms; • insects; • snails, slugs; • bacteria.
Set up a wormery.	
	State that nitrogen, carbon, sulfur and phosphorus are recycled in soil.

Can-Do Tasks

I can identify some soil fauna and flora using keys.	2 points
I can do a simple experiment to show that life is present in a soil sample (using lime water or bicarbonate indicator).	2 points
I can compare air content of two different soils.	3 points

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B4h Recycling, B4g Farming

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe a typical food web in a soil to include: • herbivores such as slugs, snails, wire worms; • detritivores such as earthworms, millipedes, springtails; • carnivores such as centipedes, spiders and ground beetles. State that most soil life depends on a supply of oxygen and water.	Interpret data on soil food webs. Explain why some life in soil depends on a supply of oxygen and water. Describe why aerating and draining will improve soils. Describe why neutralising acid soils and mixing up soil layers is important.
Describe the importance of earthworms to soil structure and fertility to include: • burying organic material for decomposition by bacteria and fungi; • aerating and draining the soil; • mixing up soil layers; • neutralising acid soil.	Recognise the part played by Charles Darwin in highlighting the importance of earthworms in agriculture.
Recognise why it is important that elements such as nitrogen, carbon, sulfur and phosphorus are recycled. State that these cycles depend on different types of bacteria.	Explain the part played by bacteria in the nitrogen cycle to include: • saprophytic soil bacteria start the decomposition; • nitrifying bacteria such as Nitrosomonas and Nitrobacter; • nitrogen fixing bacteria such as Azotobacter Clostridium and Rhizobium.

MODULE B6: BEYOND THE MICROSCOPE

Item B6f: Microscopic life in water

Summary: About two thirds of the Earth's surface is covered by water, mostly sea water. Life in water is much different from life on land yet it shows the same incredible variation. Since there seems to be so much water, we have unfortunately used it to dispose of waste causing extensive damage to aquatic life.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine microscopic life in pond water. Design an animal that can live in water and on land.	State that there is a wide variety of micro-organisms living in water. State that the variety and numbers of aquatic micro-organisms have been affected by pollution and acid rain. State that life in water is much different from life on land.
Examine living Daphnia to observe internal structures such as its heart and digestive system.	State that plankton are microscopic plants (phytoplankton) and microscopic animals (zooplankton). State that plankton have limited movement and rely on water currents. State that phytoplankton are producers in aquatic food chains and webs. State that plankton show seasonal variations.
Research the effect of marine pollution on whale species.	Analyse data on water pollution to determine pollution source: • sewage, oil, PCBs; • fertilisers, pesticides and detergents.
Can-Do Tasks I can observe a living Daphnia under a microscope.	1 point

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B4b Water, water everywhere, B2c Food factory, B4e Energy Flow. B2g Population out of control, B4f Farming

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the advantages of life in water limited to: • no problem of water shortage and dehydration; • less variation in temperature; • more support; • easy disposal of waste products. State the disadvantages of life in water limited to: • regulating water content; • resistance to movement. State that some organisms such as insects and frogs spend part of their life cycle in water and part on land to exploit both habitats.	Explain the problems of water balance caused by osmosis. Describe the action of contractile vacuoles in microscopic animals such as Amoeba. Describe the problems for animals (such as salmon) moving from salt water to fresh water.
Recall that phytoplankton are capable of photosynthesis. Describe how seasonal changes in light, temperature and availability of nitrates and phosphates cause changes in the population of plankton.	Describe how seasonal changes cause algal blooms. Interpret data on marine food webs.
Describe how sewage and fertiliser run-off can cause eutrophication, to include: • rapid growth of algae; • resulting death and decay; • using up oxygen; • causing the death of animals unable to respire. Describe how certain species of organisms are used as biological indicators for pH and oxygen levels.	Understand the accumulative, long term effect of PCBs and DDT on animals such as whales.

MODULE B6: BEYOND THE MICROSCOPE

Item B6g: Enzymes in Action

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

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Investigate the effectiveness of a biological washing powder in removing food stains. Plan or perform an investigation to find the effects of temperature, soaking time or concentration of washing powder solution on the efficiency of stain removal.	State that enzymes have everyday uses and applications such as: • in biological washing powders and stain removers; • in cheese making and juice extraction; • in the preparation of medical products such as reagent sticks; • to alter the flavour of food products. State that biological washing powders work best at a low temperature and neutral pH conditions.
Demonstrate the use of 'clinistix' or 'dextrostix' to determine the glucose concentration of a series of 'spoof urines'. (glucose dissolved in a solution of water, a trace of marmite & 1 drop of washing up liquid so it looks like urine).	Describe how and why diabetics can test their urine (using either Benedict's test or reagent strip sticks for the presence of glucose).
Show that enzymes can be immobilised in alginate beads which allows the enzyme to be recovered from a mixture if required.	Recall that some enzymes can be immobilised e.g. by using alginate. State that immobilised enzymes are often incorporated into reagent sticks (e.g. measuring glucose levels in blood).

Can-Do Tasks	
I can compare the effectiveness of biological washing powder in removing different stains.	3 points
I can test a mock urine sample for the presence of glucose.	1 points
I can use a colour chart to determine how much glucose is in the mock urine sample.	1 points
I can immobilise an enzyme in an alginate bead.	2 points
I can show that my bead contains an enzyme by showing its effect on a substrate.	3 points

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: C4e Detergents, B1b What's for Lunch? B1f Staying in Balance

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that enzymes in biological washing powders include: • amylases (to digest carbohydrates such as starch); • lipases (to digest fatty stains); • proteases (to digest protein stains). Explain why biological washing powders may not work in acidic or alkaline tap water.	Explain that the soluble products of amylase, lipase and protease activity are sugars, fatty acids and glycerol and amino acids, and that these products will then easily wash out of clothes.
Describe how sucrose can be broken down by the use of an enzyme called sucrase (invertase). Recognise that, when sucrose is broken down by enzymes, the product is much sweeter making it useful to the food industry.	Explain that because invertase converts sucrose into glucose and fructose, which are much sweeter than the sucrose, foods can be sweetened without adding so much sugar (e.g. in low calorie foods).
Describe advantages of immobilising enzymes: • that the mixture does not become contaminated with the enzyme; • that immobilised enzymes in alginate beads can be used in continuous flow processing.	Explain the principles behind the production of lactose free milk for lactose intolerant people: • immobilised lactase converts lactose in milk into glucose and galactose; • these simple sugars can then be absorbed. The same idea is used to produce cat milk since cats cannot digest lactose in milk bacteria in the cat's gut ferment the lactose producing diarrhoea and wind.

MODULE B6: BEYOND THE MICROSCOPE

Item B6h: Genetic engineering

Summary: Biotechnology is "using life to make things". Genetic engineering has the potential to alter life on Earth in a very short time span by transferring genes from one organism to another. The advantages are enormous, the long term risks high.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
	State that a cell's chromosomes contain DNA. State that DNA carries genetic information in a code called the genetic code. State that genetic engineering alters the genetic code of an organism. State that genes from one organism will work in another organism.
Extract DNA from onions or kiwi fruit. DNA fingerprinting kits (using lambda phage DNA) and gene splicing kits (using a luminous gene from jelly fish).	State that there are many uses of genetic engineering such as: • to improve crops; • to produce medicines. State that genetic engineering involves: • removing a gene from one organism; • inserting it into another organism; • the gene works in the new organism.
Research the results of pilot crops planted in the UK. Research GM crops used around the world.	State that many genetically engineered plants such as soya bean, maize and cotton are grown in many countries.
Can-Do Tasks There are no Can-Do tasks for this item.	

MODULE B6: BEYOND THE MICROSCOPE

Links to other modules: B1h Who am I?, B1g Gene Control, B3g New Genes for Old

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recall that genetic engineering alters the genetic code of an organism by inserting genes. Recall that the new type of organism is called a transgenic organism.	
Describe the main stages in genetic engineering: • identification of a desired gene in one organism; • removal of gene from DNA; • cutting open the DNA in another organism; • inserting the new gene into the DNA; • gene works in transgenic organism; • transgenic organism is then cloned to produce identical copies. Describe how bacteria can be used in genetic engineering, for example, to produce human insulin: • gene for producing human insulin cut out of human DNA; • loops of bacterial DNA called plasmids cut open; • insulin gene inserted into plasmid; • transgenic bacteria cultured by cloning; • large quantities of insulin harvested.	Describe how restriction enzymes cut open DNA and ligase enzymes rejoin DNA strands. State that assaying techniques are used to check that the new gene has been correctly transferred.
Describe how genetic engineering can improve crops by: • increasing yield; • making them resistant to weed killers; • making plants produce other chemicals such as vitamins; • helping plants survive in poor conditions.	Describe how genetic engineering improves plants by: • making them able to grow bigger/faster; • making them able to grow in conditions such as salty water or drought; • making them able to resist disease/weed killers. Discuss the advantages and disadvantages of genetic engineering.

4 Scheme of Assessment

4.1 Units of Assessment

GCSE Biology B (J643)	
Unit 1: Biology B Unit 1 – modules B1, B2, B3 (B631)	
33⅓% of the total GCSE marks 1 hour written paper 60 marks	This question paper: • is offered in Foundation and Higher Tiers; • focuses on modules B1, B2 and B3; • uses structured questions throughout (there is no choice of questions).
Unit 2: Biology B Unit 2 – modules B4, B5, B6 (B632)	
33⅓% of the total GCSE marks 1 hr written paper 60 marks	This question paper: • is offered in Foundation and Higher Tiers; • focuses on modules B4, B5 and B6; • uses structured questions throughout (there is no choice of questions).
Unit 3: Biology B Unit 3 – 'Can Do' tasks and report on 'Science in the News' (B635)	
33⅓% of the total GCSE marks Skills assessment 60 marks	Skills assessment consists of two elements: • Can-do tasks (24 marks) • Report on Science in the news (36 marks)
Unit 4: Biology B Unit 4 – Research Study, Data Task and Practical Skills (B636)	
33⅓% of the total GCSE marks Skills assessment 60 marks	Candidates produce a portfolio comprising three elements: • Research Study (24 marks) • Data Task (30 marks) • Practical Skills (6 marks)

4.2 Unit Options

Candidates must take Units 1 and 2 and either Unit 3 or Unit 4.

4.3 Tiers

All written papers are set in one of two tiers: Foundation Tier and Higher Tier. Foundation Tier papers assess grades G to C and Higher Tier papers assess Grades D to A*. An allowed grade E may be awarded on the Higher Tier components. In Units B631 and B632, candidates are entered for an option in either the Foundation Tier or the Higher Tier. Units B635 and B636 (Internal Assessment) are not tiered.

Candidates may enter for either the Foundation Tier or Higher Tier in each of the externally assessed units. So, a candidate may take, for example B631/01 and B632/02.

4.4 Assessment Availability

There are two examination sessions each year, in January and June.

	B631	B632	B635	B636
June 2007	✓	-	-	-
January 2008	✓	✓	-	-
June 2008	✓	✓	✓	✓

After June 2008, Units B631 and B632 will be available in the January and June sessions. The skills assessment, Unit B635 and B636, will only be available in the June session.

The Foundation and Higher tier papers covering the same unit will be timetabled on the same day, and will commence at the same time. The papers timetabled simultaneously will contain common questions, or part questions, targeting the overlapping grades C and D.

4.5 Assessment Objectives

The Assessment Objectives describe the intellectual and practical skills that candidates should be able to demonstrate, and which will be assessed.

Assessment Objective 1 (AO1): Knowledge and understanding of science and how science works

Candidates should be able to:

- demonstrate knowledge and understanding of the scientific facts, concepts techniques and terminology in the specification;
- show understanding of how scientific evidence is collected and its relationship with scientific explanations and theories;
- show understanding of how scientific knowledge and ideas change over time and how these changes are validated.

Assessment Objective 2 (AO2): Application of skills knowledge and understanding

Candidates should be able to:

- apply concepts, develop arguments or draw conclusions related to familiar and unfamiliar situations;
- plan a scientific task, such as a practical procedure, testing an idea, answering a question or solving a problem;
- show understanding of how decisions about science and technology are made in different situations, including contemporary situations and those raising ethical issues;
- evaluate the impact of scientific developments or processes on individuals, communities or the environment.

Assessment Objective 3 (AO3): Practical, enquiry and data-handling skills

Candidates should be able to:

- carry out practical tasks safely and skillfully;
- evaluate the methods they use when collecting first-hand and secondary data;
- analyse and interpret qualitative and quantitative data from different sources;
- consider the validity and reliability of data in presenting and justifying conclusions.

Weighting of Assessment Objectives

Assessment Objective	Weighting
AO1	34.0%
AO2	39.3%
AO3	26.6%

4.6 Quality of Written Communication

Candidates are expected to:

- present relevant information in a form that suits its purpose;
- ensure text is legible and that spelling, punctuation and grammar are accurate, so that meaning is clear.

Where appropriate they should also use a suitable structure and style of writing.

Candidates' quality of written communication will be assessed in the Report on Science in the News and the Research Study.

5 Internal Assessment

5.1 Nature of Skills Assessment

Rationale

The assessment of skills involves a variety of approaches to avoid the 'done that before' response. It provides regular feedback to candidates to ensure a sense of achievement and continuous motivation. It contains assessment targets that are achievable by the least able candidates, but differentiation to challenge and reward the most able.

Skills assessment comprises:

either Unit 3 (B635) the skills assessment similar to that of the Gateway Science B specification which comprises:

- a set of **Can-Do tasks**;
- and a report on **Science in the News**.

or Unit 4 (B636) the skills assessment similar to that of the Gateway Additional Science B specification which comprises:

- a **Research Study**;
- a **Data Task**;
- and **Practical Skills**.

The portfolio of work done during the course (for Unit B635 or Unit B636) accounts for one third of the marks for this specification. Portfolio work is assessed by teachers, internally standardised and then externally moderated.

Summary of the Elements of Unit 3 (B635)

Can-Do tasks: These are assessed and recorded throughout the course as the candidate fulfils them. The marks are recorded on the Candidate Record Card.

Report on Science in the News:. Candidates are required to use stimulus material provided by OCR and other sources of information to research the way in which scientific data and ideas are dealt with by the media. The number of reports attempted is at the discretion of the Centre, but the results of **only one** may be submitted.

Assessment element	Element marks		Weighting
Can-Do tasks	The results of 8 Can-Do tasks are submitted. These tasks are available at three levels: Basic Skills 1 point Intermediate Skills 2 points Advanced Skills 3 points Total max mark = 24 marks		13.3% overall
Report on Science in the News	A Approach to the task B Analysis of the data C Evaluation of the data D Relating the data to the issues E Justifying a conclusion F Quality of written communication Total max mark =36 marks	6 marks 6 marks 6 marks 6 marks 6 marks 6 marks	20% overall

Summary of the Elements of Unit 4 (B636)

Research Study: Candidates are required to use stimulus material provided by OCR and other sources of information to research scientific ideas. The number of reports attempted is at the discretion of the centre, but the results of **only one** may be submitted.

Data Task: Candidates are required to analyse and evaluate data and to plan further work (which will not be carried out). The number of tasks attempted is at the discretion of the centre, but the results of **only one** may be submitted.

Practical Skills: The ability carry out practical tasks to safely and skilfully is assessed holistically.

Assessment element	Element marks		Weighting
Research Study	A Collecting information B Linking information to explanations C Developing and using scientific ideas D Quality of written communication Total max mark = 24 marks	6 marks 6 marks 6 marks 6 marks	13.3% overall
Data Task	A Interpreting the data B Analysis of the data C Evaluation of the data D Justifying a conclusion E Planning further work Total max mark = 30 marks	6 marks 6 marks 6 marks 6 marks 6 marks	16.6% overall
Practical Skills	An overview of practical skills throughout the course. Total max mark = 6 marks		3.4% overall

5.2 Marking Internally Assessed Work

Unit 3 (B635) Element 1: Can – Do tasks

Mark submitted out of 24.

These tasks enable all candidates to achieve success but still provide challenge and reward for high attainers. The tasks are set at three levels:

Basic Skills: 1 point tasks	Simple tasks which should be within the reach of all candidates.
Intermediate Skills: 2 point tasks	More complex tasks which require more than one skill.
Advanced Skills: 3 point tasks	Extended tasks which require a candidate to perform a sequence of more demanding operations.

Detailed advice on assessing Can-Do tasks will be provided in guidance material published separately. Essentially however, to demonstrate proficiency at a Can-Do task, a candidate must complete the task safely and skillfully, without the help of the teacher.

Can-Do tasks are assessed on an 'all or nothing' basis: if a candidate demonstrates proficiency, the number of points associated with the task credited in full. Thus candidates may not be given partial credit for a 2 or 3 point task if the task has only been partially completed.

Opportunities to demonstrate proficiency in Can-Do tasks are indicated throughout the specification content. Results can be submitted from eight tasks. A candidate can gain a maximum of 8 points from successfully completing eight Basic Skills tasks, 16 points for eight Intermediate Skills tasks or 24 points for eight Advanced Skills tasks. Any combination of eight tasks set at different levels is acceptable. It is expected that during their course candidates will attempt a wide range of tasks at a variety of levels and that all candidates will be able to achieve success at appropriate levels. At the end of the course, results for the highest scoring eight tasks should be identified and the total points score out of a maximum of 24 should be submitted.

Unit 3 (B635) Element 2: Report on Science in the News

Mark submitted out of 36.

This element of the assessment requires candidates to use stimulus material provided by OCR, supplemented by electronic (internet, CD ROMs, databases, simulations) and/or more traditional sources of information (books, magazines, leaflets) to research the way in which scientific data and ideas are dealt with by the media. Candidates are given about a week to carry out this research and they then complete a written report, under supervision, on their findings.

The report may be submitted as a hand written or word processed document or in another suitable format, for example a PowerPoint presentation with appropriate accompanying notes.

The report should be less than 800 words in length. Reports in excess of 800 words will indicate poor structure and unselective choice of material. A written report should be illustrated by pictures, diagrams and tables as appropriate. At the end of the report the sources used should be listed, with references made to these sources in the body of the report, where appropriate.

A set of Science in the News tasks will be available from OCR. Alternatively, centres may provide their own Science in the News stimulus material and assess work using the OCR level of response grid. Advice on the suitability of such material and application of the level of response grid must be

obtained by using the OCR Internal Assessment Consultancy Service before the task is given to candidates.

Arrival at Marks for Report on Science in the News

The award of marks is based on the professional judgment of the science teacher working within a framework of performance descriptions related to various qualities. For each quality, different aspects of performance are identified in the level of response grid. For each quality, a series of three descriptions of performance (for 2, 4 and 6 marks) illustrates what might be expected for candidates working at different levels.

Marking decisions for candidates should be recorded on the Science in the News cover sheet downloaded from the OCR website www.ocr.org.uk.

Candidates may not always report their work in a particular order evidence of achievement may be located almost anywhere in the report. Thus, it is necessary to look at the whole report for evidence of each quality.

For any one quality, a tick on the grid should be used to indicate the performance statement that best matches the work. Intermediate marks of 1, 3 or 5 can be used where performance exceeds that required by one statement but does not adequately match that required by the next higher statement. When each aspect of performance has been assessed in this way, the marks are added together to give a total mark on a scale 0-36 marks.

This method of marking can be applied even where there is a wide variation between performance for different qualities. Thus, weak performance for one quality need not depress marks too far if other qualities show better performance.

Skills to be assessed (Programme of Study – PoS – references are given for each)

A: Approach to the task

The ability to plan an approach to the task, including the selection of suitable sources of data/information, which will address the issues.

Candidates are expected to be able to:

Plan to answer a scientific question (PoS 3.6ia)

Collect data from secondary sources, including the use of ICT sources and tools (PoS 3.6iib)

Apply and question scientific information or ideas (PoS 3.6iiia)

B: Analysis of the data

The ability to analyse the data/information and interpret it to show trends or patterns.

Candidates are expected to be able to:

Interpret data, using creative thought, to provide evidence for testing ideas (PoS 3.6ib)

Analyse scientific information or ideas (PoS 3.6iiia)

C: Evaluation of the data

The ability to evaluate the data/information to reach judgements about its reliability and validity.

Candidates are expected to be able to:

Consider the validity and reliability of data as evidence (PoS 3.6id)

Interpret and question scientific information or ideas (PoS 3.6iiia)

D: Relating the data to the issues

The ability to relate the data/information to social, economic and environmental issues and understand how science can contribute to decision making.

Candidates are expected to be able to:

Know why decisions about science and technology are made, including those that raise ethical issues, and know about the social, economic and environmental effects of such decisions PoS 3.6ivb)

Know that uncertainty in scientific knowledge and ideas changes over time and know the role of the scientific community in validating these changes.(PoS 3.6ivc)

E: Justifying a conclusion

The ability to draw a conclusion based on the evidence and to justify this.

Candidates are expected to be able to:

Draw a conclusion using scientific, technical and mathematical language, conventions and symbols and ICT tools (PoS 3.6iiic)

Question scientific information or ideas (PoS 3.6iiia)

F: Quality of written communication

Candidates are expected to be able to:

Develop an argument using scientific, technical and mathematical language (PoS 3.6iiic)

Science in the News Level of Response Grid

Quality Assessed		Number of Marks						
		0	1	2	3	4	5	6
A	Approach to the task			Some research is carried out; some information is collected from at least one suitable source.		The information provided is used to plan their research; information is collected from more than one suitable source and used in the report. All sources are fully referenced.		Makes good use of the information provided to structure a balanced report; information is relevant, detailed and logically presented.
B	Analysis of the data			At least one trend /pattern is identified and outlined correctly.		The main trends/patterns are described correctly and there is some evidence of correct processing of quantitative data.		The main trends/ patterns are described correctly with reference to quantitative data. These data have been further processed to reveal additional information and/or detect anomalies.
C	Evaluation of the data			A comment has been made about the quality of the evidence.		There is a comparison of the reliability of the various forms of evidence, including an attempt to identify which evidence is most/least reliable.		There is detailed consideration of the evidence showing a good understanding of the relative merits of the evidence gathered in terms of both reliability and validity.
D	Relating the data to issues			An attempt has been made to relate some of the data/information to the impact on people or the environment.		The report shows some understanding of the social, economic or environmental issues as they relate to the task.		The report shows a clear understanding of the social, economic or environmental issues as they relate to the task with an understanding of the science involved.
E	Justifying a conclusion			A conclusion is given with justification based on at least one piece of evidence.		A considered conclusion is given with justification based on the significance of more than one piece of evidence.		A considered conclusion is given with a well-argued justification based on careful analysis of the relative significance of more than one piece of evidence.
F	Quality of written communication			Spelling, punctuation and grammar are of generally poor quality. Little or no relevant scientific or technical vocabulary is used.		Spelling, punctuation and grammar are generally sound. Appropriate scientific or technical vocabulary is used.		Spelling, punctuation and grammar show very few errors. The report shows full and effective use of relevant scientific and technical terms.

Unit 4 (B636) Element 1: Research Study

Mark submitted out of 24.

This element of the assessment requires the candidates to use stimulus material provided by OCR, supplemented by electronic (internet, CD ROMs, databases, simulations) and/or more traditional sources of information (books, magazines, leaflets).

Candidates are required to research scientific ideas and the way they, for example:

- have developed over time;
- influence technological developments;
- interact with social, economic and environmental contexts.

Candidates are given about a week to carry out this research and they then complete a written report, under supervision, on their findings.

The report may be submitted as a hand written or word processed document.

The report should be less than 800 words in length. Reports in excess of 800 words will indicate poor structure and unselective choice of material. A written report should be illustrated by pictures, diagrams and tables as appropriate. At the end of the report the sources used should be listed, with references made to these sources in the body of the report, where appropriate.

A set of Research Study tasks, including detailed guidance for teachers will be available.

Arrival at Marks for Research Study

The award of marks is based on the professional judgement of the science teacher, working within a framework of performance descriptions related to various qualities. For each quality, different aspects of performance are identified in the level of response grid. For each quality, a series of three descriptions of performance (for 2, 4 and 6 marks) illustrates what might be expected for candidates working at different levels.

Marking decisions should be recorded on the Research Study cover sheet. This cover sheet can be downloaded from the OCR website www.ocr.org.uk.

Candidates may not always report their work in a particular order; evidence of achievement may be located almost anywhere in the report. Thus, it is necessary to look at the whole report for evidence of each quality.

For any one quality, a tick on the grid should be used to indicate the performance statement that best matches the work. Intermediate marks of 1, 3 or 5 can be used where performance exceeds that required by one statement but does not adequately match that required by the next higher statement. When each aspect of performance has been assessed in this way, the marks are added together to give a total mark on a scale 0-24 marks.

This method of marking can be applied even where there is a wide variation between performance for different qualities. Thus, weak performance for one quality need not depress marks too far if other qualities show better performance.

Skills to be assessed (Programme of Study – PoS – references are given for each)

A: Collecting Information

The ability to structure research to select suitable sources of information, which will address the issues.

Candidates are expected to be able to:

Provide evidence for testing ideas and developing theories (PoS 3.6ib).

Collect data from secondary sources, including the use of ICT sources and tools (PoS 3.6iib).

B: Interpreting Information

The ability to analyse information and make connections to scientific theories and models.

Candidates are expected to be able to:

Interpret data, using creative thought, to provide evidence for testing ideas (PoS 3.6ib).

Analyse scientific information or ideas (PoS 3.6iiia).

Understand that many phenomena can be explained by developing and using scientific theories, models and ideas (PoS 3.6ic).

C: Developing and using Scientific Ideas

The ability to relate research to the development of scientific ideas over time.

Candidates are expected to be able to:

Show how uncertainties in scientific theories and explanations change over time (PoS 3.6ivc).

Describe the role of the scientific community in validating these changes (PoS 3.6ivc).

Know why decisions about science and technology are made, including those that raise ethical issues and know about the social, economic and environmental effects of such decisions (POS 3.6ivb).

D: Quality of written communication

Candidates are expected to be able to:

Develop an argument using scientific, technical and mathematical language (PoS 3.6iiic).

Research Study Level of Response Grid

Quality Assessed		Number of Marks					
		1	2	3	4	5	6
A	Collecting information		An attempt has been made to collect some information from at least one suitable source.		Relevant information is collected from more than one suitable source.		Relevant, detailed information is collected from more than one suitable source and is clearly referenced in the report.
B	Interpreting information		At attempt has been made to interpret the information.		The information has been interpreted but not always thoroughly and/or correctly.		The information has been interpreted effectively, with skill and understanding.
C	Developing and using scientific ideas		An attempt has been made to describe the influences and/ or development of scientific ideas.		Demonstrates some understanding of the interaction between scientific ideas and their context.		Demonstrates a clear and detailed understanding of the interaction between scientific ideas and their context.
D	Quality of written communication		Spelling, punctuation and grammar are of generally poor quality. Little or no relevant scientific or technical vocabulary is used.		Spelling, punctuation and grammar are generally sound. Appropriate scientific or technical vocabulary is used.		Spelling, punctuation and grammar show very few errors. The report shows full and effective use of relevant scientific and technical terms.

Unit 4 (B636) Element 2: Data Task

Mark submitted out of 30.

This element of the assessment requires candidates to analyse and evaluate data.

The task will consist of two stages. In the first stage the candidates will obtain some data.

Because the actual collection of the data is not assessed, a flexible approach can be used. Some tasks will allow the candidates to collect data by using a practical procedure and they can work individually, or in pairs or small groups or as a whole class or by viewing a teacher-demonstration. For other tasks the collection of the data can be made using a CD-ROM or an internet search or a literature search. The principal reasons for the candidates having to collect the data are to:

- enhance their awareness of the techniques required;
- focus on the quality of what they have collected;
- provide help in planning the collection of further data;
- increase their access to ways of analysing and evaluating it.

For the second stage of the task the candidates can either analyse and evaluate the data they have collected or can use similar data provide by OCR.

Candidates will then work individually to complete a written report about the data which is based on questions given to them. The report will be produced under supervision.

The report may be submitted as a hand written or word processed document.

Candidates may attempt any number of the Data Tasks during the course, but the assessment of only one of them will 'count' for their GCSE award.

A set of Data Tasks, including teacher guidance, will be available.

Arrival at Marks for Data Task

The award of marks is based on the professional judgement of the science teacher working within a framework of performance descriptions related to various qualities. For each quality different aspects of performance are identified in the level of response grid. For each quality, a series of three descriptions of performance (for 2, 4 and 6 marks) illustrates what might be expected for candidates working at different levels.

Marking decisions for candidates should be recorded on the Data Task cover sheet. This cover sheet can be downloaded from the OCR website www.ocr.org.uk.

Candidates may not always report their work in a particular order; evidence of achievement may be located almost anywhere in the report. Thus, it is necessary to look at the whole report for evidence of each quality.

For any one quality, a tick on the grid should be used to indicate the performance statement that best matches the work. Intermediate marks of 1, 3 or 5 can be used where performance exceeds that required by one statement but does not adequately match that required by the next higher statement. When each aspect of performance has been assessed in this way, the marks are added together to give a total mark on a scale 0-30 marks.

This method of marking can be applied even where there is a wide variation between performance for different qualities. Thus, a weak performance for one quality need not depress marks too far if other qualities show better performance.

Detailed advice on the award of marks for each OCR-set task will be provided with the task.

Skills to be assessed (Programme of Study – PoS – references are given for each)

A: Interpreting the data

The ability to present data in such a manner as to bring out any patterns that are present.

Candidates are expected to be able to:

Interpret data, using creative thought, to provide evidence for testing ideas (PoS 3.6ib)

Present information using scientific conventions and symbols (PoS 3.6iiic)

B: Analysis of the data

The ability to analyse the data/information and interpret it to show trends or patterns.

Candidates are expected to be able to:

Interpret data, using creative thought, to provide evidence for testing ideas (PoS 3.6ib)

Analyse scientific information or ideas (PoS 3.6iiia)

C: Evaluation of the data

The ability to evaluate the data/information to reach judgements about its reliability and validity.

Candidates are expected to be able to:

Consider the validity and reliability of data as evidence (PoS 3.6id)

Interpret and question scientific information or ideas (PoS 3.6iiia)

D: Justifying a conclusion

The ability to draw a conclusion based on the evidence and to justify this.

Candidates are expected to be able to:

Draw a conclusion using scientific, technical and mathematical language, conventions and symbols and ICT tools (PoS 3.6iiic)

Question scientific information or ideas (PoS 3.6iiia)

E: Planning further work

The ability to plan further work which would help to make the conclusions more secure.

Candidates are expected to be able to:

Plan to test a scientific idea, answer a scientific question or solve a scientific problem (PoS 3.6iia)

Data Task Level of Response Grid

Quality Assessed		Number of Marks					
		1	2	3	4	5	6
A	Interpreting the data		A limited number of results are displayed in tables, charts or graphs using given axes and scales.		Data is displayed using appropriate tables, charts or graphs, allowing some errors in scaling or plotting.		Data is displayed to show general relationships using appropriate complex charts or diagrams e.g. histograms, scatter-grams, or in graphs with correctly selected scales and axes.
B	Analysis of the data		At least one trend / pattern is identified and outlined correctly.		The main trend(s)/pattern(s) are described correctly and there is some evidence of processing quantitative data.		The main trends/ patterns are described correctly with reference to the quantitative data. The data has been processed to reveal additional information and/or detect anomalies.
C	Evaluation of data		An attempt has been made to consider the quality of the data and the methods used to collect it.		There is consideration of the reliability of the data and an attempt to identify how the methods used enabled valid data to be collected.		There is detailed consideration of the data in terms of both validity and reliability and a clear appreciation of the limitations of the methods used.
D	Justifying a conclusion		A conclusion is given which is related to the data collected.		A considered conclusion is given with justification based on an analysis of the data collected and linked to the underpinning science.		A considered conclusion is given with a well-argued justification based on careful analysis of the data and clearly linked to relevant scientific knowledge and understanding.
E	Planning further work		Some consideration is given to further relevant practical work.		Relevant further practical work is planned in detail.		There is detailed consideration of relevant further practical work and a clear appreciation of how this would further understanding of the topic.

Unit 4 (B636) Element 3: Practical Skills

Mark submitted out of 6.

This element of the assessment requires the teacher to take an overview of each candidate's practical work during the course.

Arrival at Marks for Practical Skills

The award of marks is based on the professional judgment of the science teacher, working within a framework of descriptions of performance.

Skill to be assessed (Programme of Study – PoS – references are given)

Practical Skills

The ability to work safely and accurately when carrying out practical activities in science.

Candidates are expected to be able to:

Work accurately and safely, individually and with others, when collecting first-hand data.

Practical Skills Level of Response Grid

Quality Assessed	Number of Marks					
	1	2	3	4	5	6
Working safely and accurately		Practical work is carried out safely and accurately under close supervision and with much guidance.		Practical work is carried out safely and accurately with some guidance.		Practical work is carried out safely and accurately with awareness of risks.

Further detailed guidance on how to assess the practical skills will be provided in guidance to teachers.

Recording and Submitting Marks for Internally Assessed Work.

The final total mark for either Unit 3 (B635) or Unit 4 (B636) must be submitted to OCR on form MS1 by **15th May** in the year of entry for the unit. These forms are produced and despatched at the relevant time based on entry information provided by the centre.

All assessed work which has contributed to candidates' final totals must be available for moderation.

5.3 Regulations for Internally Assessed Work

Supervision and Authentication of work

OCR expects teachers to supervise and guide candidates who are undertaking work that is internally assessed. The degree of teacher guidance will vary according to the kind of work being undertaken. It should be remembered, however, that candidates are required to reach their own judgments and conclusions.

When supervising internally assessed tasks, teachers are expected to:

- offer candidates advice about how best to approach such tasks;
- exercise supervision of the work in order to monitor progress and to prevent plagiarism;
- ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the specified mark descriptions and procedures.

Work should, wherever possible, be carried out under supervision. However, it is accepted that some tasks may require candidates to undertake work outside the centre. Where this is the case, the centre must ensure that sufficient supervised work takes place to allow the teachers concerned to authenticate each candidate's work with confidence.

Production and Presentation of Internally Assessed Work

Candidates must observe certain procedures in the production of internally assessed work.

Any copied material must be suitably acknowledged;

Where work is based on the use of secondary data, the original sources must be clearly identified.

Annotation of Candidates' Work

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

The writing of comments on candidates' work provides a means of dialogue and feedback between teacher and candidate and a means of communication between teachers during the internal standardisation.

Moderation

All internally assessed work is marked by the teacher and internally standardised by the centre. Marks are then submitted to OCR by 15th May, after which moderation takes place in accordance with OCR procedures. The purpose of moderation is to ensure that the standard of the award of marks is the same for each centre and that each teacher has applied the standards appropriately across the range of candidates within the centre.

It is the responsibility of the centre to carry out effective internal standardisation to ensure that similar standards are applied by each teacher involved in the assessment. The Moderator will require a written statement describing how internal standardisation has been carried out within the centre.

External moderation will be by postal sample selected by the Moderator.

Minimum Requirements for Internally Assessed Work

If a candidate submits no work for this internally assessed unit, then the candidate should be indicated as being absent from that unit on the mark sheets submitted to OCR. If a candidate completes any work at all for an internally assessed unit, then the work should be assessed and the appropriate mark awarded, which may be zero.

6 Technical Information

6.1 Making Unit Entries

Please note that centres must be registered with OCR in order to make any entries, including estimated entries. It is recommended that centres apply to OCR to become a registered centre well in advance of making their first entries. Centres should be aware that a minimum of ten candidates for summer examinations is normally required.

Unit Entry Options

Within Units B631 and B632 candidates must be entered for either the Foundation Tier or the Higher Tier option. It is not necessary for candidates to enter at the same tier in every unit. Candidates may, if they wish, attempt papers at both tiers, but **not in the same examination session**, since the papers will be timetabled simultaneously.

Entry code	Option code	Component to be taken	
B631	F	01	Biology B Unit 1 – modules B1, B2, B3 Foundation
	H	02	Biology B Unit 1 – modules B1, B2, B3 Higher
B632	F	01	Biology B Unit 2 – modules B4, B5, B6 Foundation
	H	02	Biology B Unit 2 – modules B4, B5, B6 Higher
B635	-	01	Biology B Unit 3 – 'Can do' tasks and report on Science in the News
B636	-	01	Biology B Unit 4 – Research Study, Data Task and Practical Skills

Candidate entries must be made by 21 October for the January session and by 21 February for the June session.

6.2 Making Qualification Entries

Candidates must be entered for certification code **J643** to claim their overall GCSE grade.

If a certification entry is not made, no overall grade can be awarded.

A candidate who has completed all the units required for the qualification may enter for certification either in the same examination session (within a specified period after publication of results) or at a later session.

First certification will be available in June 2008 and every January and June thereafter.

Certification cannot be declined.

6.3 Grading

GCSE results are awarded on the scale A*-G. Units are awarded a* to g. Grades are awarded on certificates. Results for candidates who fail to achieve the minimum grade (G or g) will be recorded as *unclassified* (U or u).

In unitised schemes candidates can take units across several different sessions. They can also re-sit units or choose from optional units where available. When working out candidates' overall grades OCR needs to be able to compare performance on the same unit in different sessions when different grade boundaries have been set, and between different units. OCR uses uniform marks to enable this to be done.

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

When unit results are issued, the candidate's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit e.g. 71/100.

Results for each unit will be published in the form of uniform marks according to the following scales.

	Unit Grade								
	a*	a	b	c	d	e	f	g	u
Units 1, 2 3 and 4	100-90	89-80	79-70	69-60	59-50	49-40	39-30	29-20	19-0

Higher tier candidates may achieve an "allowed e". Higher tier candidates who miss a grade e will be given a uniform mark in the range f-u but will be graded as 'u'.

Candidates' uniform marks for each module are aggregated and grades for the specification are generated on the following scale.

Qualification Grade								
A*	A	B	C	D	E	F	G	U
300-270	269-240	239-210	209-180	179-150	149-120	119-90	89-60	59-0

The candidate's grade will be determined by this total mark. Thus, the grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of the assessment may be balanced by better performance in others. Candidates achieving less than the minimum mark for grade G will be unclassified.

6.4 Result Enquiries and Appeals

Under certain circumstances, a centre may wish to query the grade available to one or more candidates or to submit an appeal against an outcome of such an enquiry. Enquiries about unit results must be made immediately following the series in which the relevant unit was taken.

For procedures relating to enquires on results and appeals, centres should consult the OCR *Handbook for Centres* and the document *Enquiries about Results and Appeals – Information and Guidance for Centres* produced by the Joint Council. Copies of the most recent editions of these papers can be obtained from OCR.

6.5 Shelf-Life of Units

Individual unit results, prior to certification of the qualification, have a shelf-life limited only by that of the qualification.

6.6 Unit and Qualification Re-sits

Candidates may re-sit any unit an **unlimited** number of times.

For each unit the best score will be used towards the final overall grade.

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

6.7 Guided Learning Hours

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

6.8 Code of Practice/Subject Criteria/Common Criteria Requirements

These specifications comply in all respects with the revised *GCSE, GCE, VCE, GNVQ and AEA Code of Practice 2005/6*, the subject criteria for GCSE Biology and *The Statutory Regulation of External Qualifications 2004*.

6.9 Arrangements for Candidates with Particular Requirements

For candidates who are unable to complete the full assessment or whose performance may be adversely affected through no fault of their own, teachers should consult the *Access Arrangements and Special Consideration Regulations and Guidance Relating to Candidates who are Eligible for*

Adjustments in Examinations. In such cases advice should be sought from OCR as early as possible during the course.

6.10 Prohibited Qualifications and Classification Code

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

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

The classification code for this specification is 1010.

7 Other Specification Issues

7.1 Overlap with other Qualifications

This specification has been developed alongside GCSE Science; GCSE Additional Science; GCSE Chemistry; GCSE Physics.

7.2 Progression from these Qualifications

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

Many candidates who enter employment with one or more GCSEs will undertake training or further part-time study with the support of their employers.

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Candidates who are awarded mainly grades G to D at GCSE may either strengthen their base through further study of qualifications at Foundation Level (Level1) or Intermediate level (Level 2), for example OCR GCSE Applied Science (Double Award), OCR Additional Applied Science. Candidates who are awarded grades C to A* at GCSE are well prepared to broaden their base through further study of qualifications at Intermediate Level, for example, OCR GCSE Applied Science (Double Award), OCR Additional Applied Science or study at Advanced Level (Level 3) within the National Qualifications Framework.

7.3 ICT

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

Opportunities for ICT include:

- gathering information from the World Wide Web and CD-ROMs;
- gathering data using sensors linked to data-loggers or directly to computers;
- using spreadsheets and other software to process data;
- using animations and simulations to visualise scientific ideas;
- using software to present ideas and information on paper and on screen.

The examples listed in the table show some points in the specification where opportunities might more easily be found.

ICT	Possible Opportunities
Gathering information	Internal Assessment B1b, B1e, B2e, B2h, B3c, B4d, B5e, B6h, B4f, B4g
Datalogging	Internal Assessment B1f, B3c, B4c, B2a, B6a, B1a
Processing data	Internal Assessment B1a, B1d, B2a
Visualisation	Internal Assessment B3a, B3d, B5b
Making presentations	Internal Assessment B1e, B1f, B3c, B2f

7.4 Citizenship

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

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

Citizenship Programme of Study	Examples of opportunities for Teaching the Issues during the Course
Section 1: Knowledge and understanding about becoming informed citizens	
The work of parliament, the government and the courts in making and shaping the law	
How the economy functions, including the role of business and financial services	
The opportunities for individuals and voluntary groups to bring about social change locally, nationally, in Europe and internationally	
The media's role in society, including the internet, in providing information and affecting opinion	Internal Assessment B1h
The rights and responsibilities of consumers, employers and employees	B3c
The issues and challenges of global interdependence and responsibility, including sustainable development and Local Agenda 21	B3g, B6d
Section 2 : Enquiry and communication	
Researching a topical scientific issue by analysing information from different sources, including ICT-based sources, showing an awareness of the use and abuse of statistics	Internal Assessment B1e, B1b, B1f, B3c, B5g
Expressing, justifying and defending orally and in writing a personal opinion about a topical scientific issue.	Internal Assessment B1e, B1h
Contributing to group and class discussions	Internal Assessment B1c, B1e, B1h, B3e, B3g, B2e
Section 3: Developing skills of participation and responsible action	
Consider and evaluate views that are not their own	Internal Assessment B1e, B2h, B3g
Participating in science-based school and community activities	B2d, B5f, B4f

7.5 Key Skills

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

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

Level	Communication				Application of Number			IT			Working with Others			Improving Own Learning and Performance			Problem Solving		
	.1a	.1b	.2	.3	.1	.2	.3	.1	.2	.3	.1	.2	.3	.1	.2	.3	.1	.2	.3
1			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
2			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

7.6 Spiritual, Moral, Ethical, Social, Legislative, Economic and Cultural Issues

Spiritual, moral, ethical, social and cultural issues are a major feature of this specification. The content of this course includes aspects which have a profound influence on how people think about themselves, their immediate environment, the Earth as a whole and the Universe.

Issue	Examples of opportunities for Teaching the Issues during the Course
The commitment of scientists to publish their findings and subject their ideas to testing by others.	B1g, B2b, B2f, B6b
Risk and the factors which decide the level of risk people are willing to accept in different circumstances.	B1c, B3g, B5c, B5g, B6h
The range of factors which have to be considered when weighing the costs and benefits of scientific activity.	Internal Assessment B3g, B4f, B5a, B6h
The ethical implications of selected scientific issues.	B1h, B2h, B3c, B3e, B3g, B3h, B4f, B5f, B5g, B6h
Scientific explanations which give insight into human nature.	B3a, B5b
Scientific explanations which give insight into the local and global environment.	Internal Assessment B2a, B2g, B2h, B6d, B6h
Scientific explanations which give insight into our planet and its place in the Universe	B2a, B2f

7.7 Sustainable Development, Health and Safety Considerations and European Developments

OCR has taken account of the 1988 Resolution of the Council of the European Community and the Report Environmental Responsibility: An Agenda for Further and Higher Education, 1993 in preparing this specification and associated specimen assessments.

Issue	Examples of opportunities for Teaching the Issues during the Course
Environmental issues	
Air pollution	B2g
Natural disasters and how to predict them	B6b
Food and agriculture	B2h, B3f, B3g, B4f, B6e, B6h
Origins and management of waste materials	B2g, B4g, B4h, B6f
Energy resources	B6d
Health and Safety issues	
Safe practice in the laboratory	There will be opportunities to demonstrate safe practice in the laboratory in most modules. Internal Assessment
Health and disease	B1a, B1c, B1d, B1e, B1f, B3c, B2f, B3e, B5a, B5b, B5d, B5f, B5g, B6b
Food and nutrition	B1b, B4e, B4g, B6a, B6g
Living with radiation	B1h, B5a

Although this specification does not make specific reference to the European dimension it may be drawn into the course of study in a number of ways. The table below provides some appropriate opportunities.

Issue	Examples of opportunities for Teaching the Issues during the Course
The importance of the science-based industry to European economies	B4f
Environmental issues which extend over a larger area than the UK	B2h, B1b, B2f
Differences in attitudes to key issues in different parts of Europe	B1c

7.8 Avoidance of Bias

OCR has taken great care in preparation of these specifications and assessment materials to avoid bias of any kind.

7.9 Language

These specifications and associated assessment materials are in English only.

7.10 Support and Resources

Support and additional resources are available from the OCR GCSE science website **www.gcse-science.com** where centres should register their intention to offer this qualification. Registering on this site provides access to a teachers' forum and local support networks.

Appendix A: Grade Descriptions

Grade F

Candidates demonstrate a limited knowledge and understanding of science content and how science works. They use a limited range of the concepts, techniques and facts from the specification, and demonstrate basic communication and numerical skills, with some limited use of technical terms and techniques.

They show some awareness of how scientific information is collected and that science can explain many phenomena.

They use and apply their knowledge and understanding of simple principles and concepts in some specific contexts. With help they plan a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem, using a limited range of information in an uncritical manner. They are aware that decisions have to be made about uses of science and technology and, in simple situations familiar to them, identify some of those responsible for the decisions. They describe some benefits and drawbacks of scientific developments with which they are familiar and issues related to these.

They follow simple instructions for carrying out a practical task and work safely as they do so.

Candidates identify simple patterns in data they gather from first-hand and secondary sources. They present evidence as simple tables, charts and graphs, and draw simple conclusions consistent with the evidence they have collected.

Grade C

Candidates demonstrate a good overall knowledge and understanding of science content and how science works, and of the concepts, techniques, and facts across most of the specification. They demonstrate knowledge of technical vocabulary and techniques, and use these appropriately. They demonstrate communication and numerical skills appropriate to most situations.

They demonstrate an awareness of how scientific evidence is collected and are aware that scientific knowledge and theories can be changed by new evidence.

Candidates use and apply scientific knowledge and understanding in some general situations. They use this knowledge, together with information from other sources, to help plan a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem.

They describe how, and why, decisions about uses of science are made in some familiar contexts. They demonstrate good understanding of the benefits and risks of scientific advances, and identify ethical issues related to these.

They carry out practical tasks safely and competently, using equipment appropriately and making relevant observations, appropriate to the task. They use appropriate methods for collecting first-hand and secondary data, interpret the data appropriately, and undertake some evaluation of their methods.

Candidates present data in ways appropriate to the context. They draw conclusions consistent with the evidence they have collected and evaluate how strongly their evidence supports these conclusions.

Grade A

Candidates demonstrate a detailed knowledge and understanding of science content and how science works, encompassing the principal concepts, techniques, and facts across all areas of the specification. They use technical vocabulary and techniques with fluency, clearly demonstrating communication and numerical skills appropriate to a range of situations.

They demonstrate a good understanding of the relationships between data, evidence and scientific explanations and theories. They are aware of areas of uncertainty in scientific knowledge and explain how scientific theories can be changed by new evidence.

Candidates use and apply their knowledge and understanding in a range of tasks and situations. They use this knowledge, together with information from other sources, effectively in planning a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem.

Candidates describe how, and why, decisions about uses of science are made in contexts familiar to them, and apply this knowledge to unfamiliar situations. They demonstrate good understanding of the benefits and risks of scientific advances, and identify ethical issues related to these.

They choose appropriate methods for collecting first-hand and secondary data, interpret and question data skilfully, and evaluate the methods they use. They carry out a range of practical tasks safely and skilfully, selecting and using equipment appropriately to make relevant and precise observations.

Candidates select a method of presenting data appropriate to the task. They draw and justify conclusions consistent with the evidence they have collected and suggest improvements to the methods used that would enable them to collect more valid and reliable evidence.

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Appendix B: Requirements Relating to Mathematics

During the course of study for this specification, many opportunities will arise for quantitative work, including appropriate calculations. The mathematical requirements which form part of the specification are listed below. Items in the first table may be examined in written papers covering both Tiers. Items in the second table may be examined only in written papers covering the Higher Tier.

Both Tiers
add, subtract, multiply and divide whole numbers
recognise and use expressions in decimal form
make approximations and estimates to obtain reasonable answers
use simple formulae expressed in words
understand and use averages
read, interpret, and draw simple inferences from tables and statistical diagrams
find fractions or percentages of quantities
construct and interpret pie-charts
calculate with fractions, decimals, percentage or ratio
solve simple equations
substitute numbers in simple equations
interpret and use graphs
plot graphs from data provided, given the axes and scales
choose by simple inspection and then draw the best smooth curve through a set of points on a graph
Higher Tier only
recognise and use expressions in standard form
manipulate equations
select appropriate axes and scales for graph plotting
determine the intercept of a linear graph
understand and use inverse proportion
calculate the gradient of a graph
statistical methods e.g. cumulative frequency, box plots, histograms

Appendix C: Physical Quantities and Units

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

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

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

Appendix D: Health and Safety

In UK law, health and safety is the responsibility of the employer. For most Centres entering candidates for GCSE examinations this is likely to be the Local Education Authority or the Governing Body. Teachers have a duty to co-operate with their employer on health and safety matters. Various regulations, but especially the COSHH Regulations 1996 and the Management of Health and Safety at Work Regulations 1992, require that before any activity involving a hazardous procedure or harmful microorganisms is carried out, or hazardous chemicals are used or made, the employer must provide a risk assessment.

A useful summary of the requirements for risk assessment in school or college science can be found in Chapter 4 of Safety in Science Education. For members, the CLEAPSS guide, Managing Risk Assessment in Science offers detailed advice.

Most education employers have adopted a range of nationally available publications as the basis for their Model Risk Assessments. Those commonly used include:

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

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

Safeguards in the School Laboratory, 10th edition, 1996, ASE ISBN 0 86357 250 2;

Hazcards, 1995 with 1998 and 2000 updates, CLEAPSS School Science Service;*

CLEAPSS Laboratory Handbook, 1997 with 2001 update, CLEAPSS School Science Service;*

CLEAPSS Shorter Handbook (CLEAPSS 2000) CLEAPSS School Science Service;*

Hazardous Chemicals, A manual for Science Education, (SSERC, 1997) ISBN 0 9531776 0 2.

**Note that CLEAPSS publications are only available to members or associates.*

Where an employer has adopted these or other publications as the basis of their model risk assessments, an individual Centre then has to review them, to see if there is a need to modify or adapt them in some way to suit the particular conditions of the establishment. Such adaptations might include a reduced scale of working, deciding that the fume cupboard provision was inadequate or the skills of the candidates were insufficient to attempt particular activities safely.

The significant findings of such risk assessment should then be recorded, for example on schemes of work, published teachers guides, work sheets, etc.

There is no specific legal requirement that detailed risk assessment forms should be completed, although a few employers require this.

When candidates are planning their own investigative work the teacher has a duty to check the plans before the practical work starts and to monitor the activity as it proceeds.