OCR
RECOGNISING ACHIEVEMENT

GCSE

Science B

Gateway Science Suite

OCR GCSE in Science B J640

Foreword to the Third Edition (October 2008)

This Third Edition of the OCR GCSE Science 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 115). Section 6.7 has been updated to be in line with other GCSE Specifications.

QAN 100/5632/4

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 Science Specification

This booklet contains OCR's GCSE specification in Science B for teaching from September 2006 and first certification in June 2007.

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

This is achieved by:

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

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

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

Unit	Unit Code	Title	Duration	Weighting	Total Mark
1	B621	Science B Unit 1 – modules B1, C1, P1	1 hour	33⅓%	60
2	B622	Science B Unit 2 – modules B2, C2, P2	1 hour	33⅓%	60
3	B625	Science B Unit 3 – 'Can-Do' tasks and report on Science in the News	-	33⅓%	60

1.3 Qualification Titles and Levels

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

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

Candidates who gain grades G to D will have achieved an award at Foundation Level (Level 1 of the NQF).
Candidates who gain grades C to A* will have achieved an award at Intermediate Level (Level 2 of the NQF).

1.4 Aims

This specification therefore aims to give candidates opportunities to:

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

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 taking 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 modules, predominantly Biology, Chemistry and Physics. 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 C1: Carbon Chemistry	Module P1: Energy for the Home
a Fit for Life	a Cooking	a Heating Houses
b What's for Lunch?	b Food Additives	b Keeping Homes Warm
c Keeping Healthy	c Smells	c How Insulation Works
d Keeping in Touch	d Making Crude Oil Useful	d Cooking with Waves
e Drugs and You	e Making Polymers	e Infra-red Signals
f Staying in Balance	f Designer Polymers	f Wireless Signals
g Gene Control	g Using Carbon Fuels	g Light
h Who am I?	h Energy	h Stable Earth
Module B2: Understanding Our Environment	**Module C2: Rocks and Metals**	**Module P2: Living for the Future**
a Ecology in our School Ground	a Paints and Pigments	a Collecting Energy from the Sun
b Grouping Organisms	b Construction Materials	b Power Station 1
c The Food Factory	c Does the Earth Move?	c Power Station 2
d Complete or Die	d Metals and Alloys	d Nuclear Radiations
e Adapt to Fit	e Cars for Scrap	e Our Magnetic Field
f Survival of the Fittest	f Clean Air	f Exploring Our Solar System
g Population out of Control?	g Faster or Slower (1)	g Threats to Earth
h Sustainability	h Faster or Slower (2)	h The Big Bang

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 Microorganisms

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 grows. 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, B3e Growing Up, B3g New Genes for Old, B3h More of the Same, B5d Breath of Life, B5e 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 B6h Genetic Engineering, B5h Size Matters

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 C1: CARBON CHEMISTRY

Item C1: Fundamental chemical concepts

Summary: Throughout the study of chemistry there are a number of ideas and concepts that are fundamental. These ideas and concepts have not been put into a particular item but should permeate all the Chemistry units. They will be assessed in the context of any of the modules C1 to C6.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
These Learning Outcomes are intended to be taught throughout this specification.	Describe that in a chemical reaction reactants are changed into products. Recognise the reactants and products in a word or symbol equation. Recognise that in a chemical change no atoms are lost or made.
These Learning Outcomes are intended to be taught throughout this specification.	State the number of elements in a compound given its formula. State the number of atoms in a formula with no brackets. State the number of each different type of atom in a formula with no brackets.
These Learning Outcomes are intended to be taught throughout this specification.	Recognise whether a substance is an element or a compound from its formula.
These Learning Outcomes are intended to be taught throughout this specification.	Recognise that a molecule is made up of more than one atom joined together. Recognise that a molecular formula shows the number and type of atom in a molecule. State the number of atoms in a displayed formula. State the names of the different elements in a compound given its displayed formula. State the number of each different type of atom in a displayed formula.
These Learning Outcomes are intended to be taught throughout this specification.	State that all atoms are made up of a nucleus and electrons. State that a chemical bond holds atoms together in a compound.

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1 to C6

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Construct word equations given the reactants and products. Construct balanced symbol equations given the formulae (no brackets) of the reactants and products. Explain that a symbol equation is balanced when the number of each type of atom is the same on both sides of an equation.	Construct balanced symbol equations given the formulae (some or all with brackets) of the reactants and products. Construct balanced symbol equations given the names of the reactants and products (limited to the learning outcomes in this specification).
State the number of atoms in a formula with brackets. State the number of each type of different atom in a formula with brackets.	Recall the formula of the following substances: • carbon dioxide and carbon monoxide; • water and oxygen; • methane and ethane.
Recognise that a displayed formula shows both the atoms and the covalent bonds in a molecule. Write the molecular formula of a compound given its displayed formula.	Balance equations that use displayed formulae.
State that the nucleus of an atom is positive and the electrons negative. State there are two types of chemical bonds: • ionic between a positive ion and a negative ion; • covalent involving a shared pair of electrons.	

MODULE C1: CARBON CHEMISTRY

Item C1a: Cooking

Summary: Cooking involves chemical reactions in food to develop a different texture and taste. New ways of cooking food have been developed. This item considers some of the ways in which food is cooked and the chemical changes that happen to some foods when they are cooked.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey of the different types of food. Produce a leaflet describing the scientific principles about how a microwave heats food. Look at the different ways food can be heated or cooked (microwave, oven, boiling, frying, grilling, steaming). Heat water contained in an block of ice shaped as a beaker in a microwave and watch the water boil. Reverse baked alaska (ice cream on outside, meringue on inside).	State two examples of foods that can be eaten raw and two that must be cooked. State examples of different ways that can be used to cook food: • microwave; • conventional oven; • boiling; • steaming; • grilling; • frying.
Investigate the effect of heating on proteins. Investigate the effect of heat on potatoes.	Recognise that a chemical change takes place if: • there is a new substance made; • the process is irreversible; • an energy change takes place. State that the process of cooking food is an example of a chemical change. Describe the changes that occur when an egg or meat is cooked: • change in appearance; • change in texture. Describe how the texture and taste of a potato changes when it is heated.
Investigate the action of heat on baking powder.	State that baking powder gives off carbon dioxide gas when it is heated. State that baking powder is used for baking cakes. Explain that the carbon dioxide made when baking powder is heated helps make cakes rise. State that carbon dioxide turns lime water cloudy.

Can-Do Tasks	
I can heat a solid substance safely.	1 point
I can test for carbon dioxide.	1 point

MODULE C1: CARBON CHEMISTRY

Links to other modules: C5a Moles and Empirical Formulae, P1d Cooking with Waves

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe reasons why some foods must be cooked before they are eaten: • the high temperature kills microbes; • improve the texture; • improve the taste; • improve the flavour; • easier to digest.	
Explain that cooking food is a chemical change because a new substance is formed and the process cannot be reversed. State that eggs or meat are good sources of proteins. State that protein molecules in eggs and meat change shape when eggs and meat are cooked. State that potatoes are a good of source of carbohydrates.	Explain the changes that occur to an egg or meat when it is cooked: • shape of protein molecules change; • the process is irreversible; • the process is called denaturing. Explain the changes that happen to a potato when it is cooked in terms of changes to the cell wall and how this makes the potato easier to digest.
State that baking powder contains sodium hydrogencarbonate. Describe that sodium hydrogencarbonate breaks down when heated (decomposes) to make sodium carbonate, carbon dioxide and water. Write the balanced word equation for the decomposition of baking powder: sodium hydrogencarbonate → sodium carbonate + carbon dioxide + water Describe the chemical test for carbon dioxide.	Write the balanced symbol equation for the decomposition of sodium hydrogencarbonate. $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

MODULE C1: CARBON CHEMISTRY

Item C1b: Food Additives

Summary: Young people are concerned about the food that they eat. Much of the food eaten today contains food additives to colour food, enhance the flavour, add vitamins, stabilise the food, or to stop it from decaying. This item considers different types of food additive and some of the issues concerned with their use. The importance of active and intelligent packaging is also considered. This item provides the opportunity to collect and analyse secondary data using ICT tools when researching food additives. Active and intelligent packaging involves finding out about contemporary scientific and technological developments and provides opportunities for interpreting and applying science ideas.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Data search into the types of food additives and the E number classification e.g. using suitable web sites. Look at food labels for additives. Discuss the advantages and disadvantages of using food additives.	State that everything in food is made from chemicals. State that some additives can be harmful to certain individuals.
	State the main types of food additives: • antioxidants; • food colours; • emulsifiers; • flavour enhancers. Interpret the relative amounts of the constituents of a food from its label.
Investigate the packaging of food products.	State that antioxidants stop food from reacting with oxygen.
Investigate emulsifiers by mixing oil and water.	State that oil and water do not mix. State that emulsifiers help oil and water to mix and not separate.
Can-Do Tasks There are no Can-Do Tasks for this section.	

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1a Cooking, C4e Detergents and C6g Natural fats and Oils

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Interpret given information about food additives and E numbers (no recall is expected). Explain why a particular food additive is added to a food given details about the food.	
State two examples of foods containing added antioxidants. Describe two examples of how active or intelligent packaging is used to improve the quality or safety of food: • cans which will heat or cool contents; • removal of water inside the pack. Interpret information on intelligent packaging given relevant data.	Explain how and why active packaging is used in food packaging: • active packaging involves the material controlling or reacting to things which are taking place inside package to improve the quality or safety of the products; • removal of water will make it more difficult for bacteria or mould to grow.
Describe emulsifiers as molecules that have a water loving part (hydrophilic) and an oil or fat loving (hydrophobic) part. State examples of foods that contain emulsifiers e.g. mayonnaise.	Describe how an emulsifier helps to keep oil and water from separating: • hydrophilic end bonds to water molecules; • hydrophobic end bonds with oil molecules.

MODULE C1: CARBON CHEMISTRY

Item C1c: Smells

Summary: Cosmetics play an important part in the life of teenagers. This item considers some cosmetic products; perfumes and nail varnish remover. The properties of these products and the need for testing new cosmetic products are considered. This item provides the opportunity to explore how and why decisions about science and technology are made, including ethical issues on the testing of cosmetics on animals. The investigation on nail varnish removal provides the opportunity to collect and analyse primary scientific data, working accurately and safely.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Preparation of an ester e.g. butyl ethanoate. Microscale preparation of a range of esters and identifying the smells. Look at the uses of esters.	State that some cosmetics are made from natural sources. State two examples of perfumes obtained from natural sources. State that some cosmetics are synthetic (made by human action). Describe that esters are perfumes that can be made synthetically.
Discuss the properties of perfumes.	State that perfumes have a pleasant smell. Describe that perfumes are smelly because they stimulate sense cells in the nose. Interpret physical properties to decide which are needed by a perfume: • evaporates easily; • non-toxic; • does not react with water; • does not irritate the skin; • insoluble in water.
Investigate the removal of coloured nail varnish with different solvents.	State that nail-varnish remover dissolves nail varnish colours. State that substances that dissolve in a liquid are soluble and those that do not are insoluble. State that a solute is the substance dissolved in a solution. State that a solvent is the liquid that does the dissolving. Interpret information on the effectiveness of solvents given relevant data.
Debate: “Is the testing of cosmetics on animals justified?”	State that some cosmetics are tested on animals. State that cosmetics must be tested to ensure that they are safe to use.
Can-Do Tasks I can test whether a substance dissolves in a solvent.	1 point

MODULE C1: CARBON CHEMISTRY

Links to other modules: C2a Paints and Pigments, C4e Detergents, C6g Natural Fats and Oils

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that alcohols react with acids to make an ester and water. Describe how to carry out a simple experiment to make an ester. State that esters are used as perfumes.	
Explain why a perfume needs certain properties: • easily evaporates so that the perfume particles can easily reach the nose; • non-toxic so it does not poison you; • does not react with water because otherwise the perfume would react with perspiration; • does not irritate the skin otherwise the perfume could not be put directly on the skin; • insoluble in water so it cannot be washed off easily.	Explain the volatility (ease of evaporation) of perfumes in terms of kinetic theory: • particles with lots of energy can escape the attraction to other molecules in the liquid; • only weak attraction between particles in the liquid perfume so easy to overcome this attraction.
State that esters can be used as solvents. State that a solution is a mixture of solvent and solute that does not separate out. Interpret information on the effectiveness of solvents (no recall expected).	Explain why water will not dissolve nail varnish colours: • attraction between water molecules is stronger than attraction between water molecules and particles in nail varnish; • attraction between particles in nail varnish is stronger than attraction between water molecules and particles in nail varnish.
Explain why new cosmetic products need to be thoroughly tested before they are permitted to be used. Describe one advantage and one disadvantage of testing cosmetics on animals.	

MODULE C1: CARBON CHEMISTRY

Item C1d: Making Crude Oil Useful

Summary: Articles on television and in newspapers show the unacceptable side of oil exploitation in terms of oil pollution at sea or on beaches. This item develops ideas about oil exploitation and how crude oil is changed into useful products such as fuels.

This item provides the opportunity to illustrate the use of ICT in science and technology when researching oil exploitation and the industrial production of products from crude oil. The discussion about exploitation of oil raises ethical issues and allows consideration of some questions that science cannot currently answer.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Research different fossil fuels with groups of candidates preparing a presentation on each fuel.	State that crude oil, coal and gas are fossil fuels. Describe non-renewable fuels as ones which take a very long time to make and are used up faster than they are formed.
Demonstrate the fractional distillation of crude oil using synthetic crude oil mixture. Look at the different products that can be made from crude oil.	Recognise that fractional distillation separates crude oil into useful products called fractions. Recognise that fractional distillation works because of differences in boiling points. Know that LPG, petrol, diesel, paraffin, heating oil, fuel oils and bitumen are fractions obtained from crude oil. State that LPG contains propane and butane gases.
Research the problems of oil exploitation and possible solutions.	Understand that crude oil is often found in the Earth's crust and may have to be pumped to the surface. Describe some of the environmental problems involved in the exploitation of crude oil: • oil slicks; • damage to wildlife and beaches.
Demonstrate the cracking of liquid paraffin.	Label the laboratory apparatus used for cracking liquid paraffin. Describe cracking as a process that: • needs a catalyst and a high temperature; • converts large hydrocarbon molecules into smaller ones that are more useful; • makes more petrol.
Can-Do Tasks There are no Can-Do Tasks for this section.	

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1e Making Polymers, C1g Using Carbon Fuels, C6g Natural Fats and Oils, P2c Fuels for Power

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain why fossil fuels are finite resources and are non-renewable. Describe crude oil as a mixture of many hydrocarbons.	
Label a diagram of a crude oil fractional distillation column to show the main fractions and the temperature gradient. Describe the fractional distillation of crude oil into fractions: • crude oil is heated; • use of a fractionating column which has a temperature gradient (cold at the top and hot at the bottom); • fractions containing mixtures of hydrocarbons are obtained; • fractions contain many substances with similar boiling points; • fractions with a low boiling points 'exit' from the top of the fractionating column; • fractions with high boiling points 'exit' at the bottom of the fractionating column.	Explain why crude oil can be separated by fractional distillation: • covalent bonds between carbon and hydrogen atoms within a hydrocarbon molecule are stronger than the intermolecular forces between hydrocarbon molecules; • during boiling intermolecular forces are broken; • intermolecular forces between large hydrocarbon molecules are stronger than those between smaller hydrocarbon molecules; • hydrocarbons with large molecules have a higher boiling temperature than those with smaller molecules.
Explain some of the environmental problems involved in the exploitation of crude oil.	Discuss in simple terms the political problems associated with the exploitation of crude oil.
Describe cracking as a process that: • converts large alkane molecules into smaller alkane and alkene molecules; • makes useful alkene molecules because they can be used to make polymers ; • interpret data about the supply and demand of crude oil fractions (no recall expected).	Explain how cracking helps an oil refinery match its supply of useful products such as petrol with the demand for them.

MODULE C1: CARBON CHEMISTRY

Item C1e: Making polymers

Summary: Candidates will be familiar with the idea that virtually all materials are made through chemical reactions. They will also be able to represent compounds by formulae and chemical reactions by word equations. This item applies these ideas to the formation of a group of substances vital for life in the 21st century.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Card game: matching monomers and polymers. Use of molecular models. Making 'polypaperclips'.	State the name of an addition polymer given the name of the monomer and vice versa.
Demonstration of preparation of nylon as an example of how monomers can form chains (but understanding that this is not an example of addition polymerisation).	State that polymers are very large molecules. State that molecules in plastics are called polymer molecules. State that polymers are made when many small molecules called monomers join together. State that the reaction that makes polymers from monomers is called polymerisation.
Use of molecular models. Use of ICT to show shapes of molecules.	State the two elements chemically combined in a hydrocarbon: • carbon; • hydrogen. Recognise a hydrocarbon from its molecular or displayed formula.
Use of molecular models. Use of ICT to show shapes of molecules.	State that alkanes are hydrocarbons. Interpret information about structure from their names: • methane; • ethene; • propane; • butane; are all alkanes.
Test for unsaturation using bromine water.	State that alkenes are hydrocarbons. Interpret information about structure from their names: • ethene; • propene; • butene; are all alkenes.
Can-Do Tasks I can test for unsaturation.	2 points

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1d Making Crude Oil Useful, C1f Designer Polymers and C6g Natural Fats and Oils

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recognise the displayed formula for a polymer.	Construct the displayed formula of an addition polymer given the displayed formula of its monomer. Construct the displayed formula of a monomer given the displayed formula of an addition polymer.
Describe polymerisation as a process in which many monomer molecules react together to give a polymer which requires high pressure and a catalyst.	Explain that addition polymerisation involves the reaction of many unsaturated monomer molecules (alkenes) to form a saturated polymer.
Describe a hydrocarbon as a compound formed between carbon atoms and hydrogen atoms only. Explain why a compound is a hydrocarbon given its molecular or displayed formula.	Describe a saturated compound as one which contains only single covalent bonds between carbon atoms. Describe an unsaturated compound as one which contains at least one double covalent bond between carbon atoms.
Describe alkanes as hydrocarbons which contain single covalent bonds only. Interpret information on displayed formula of alkanes.	Interpret information on displayed formula of a saturated hydrocarbon. Explain that hydrogen atoms and carbon atoms share an electron pair to form a covalent bond.
Describe alkenes as hydrocarbons which contain one or more double covalent bond(s) between carbon atoms. Interpret information on displayed formulae of alkenes.	Interpret information on displayed formula of an unsaturated hydrocarbon. Describe how the reaction with bromine can be used to test for unsaturation.

MODULE C1: CARBON CHEMISTRY

Item C1f: Designer polymers

Summary: Candidates may be familiar with the idea that everyday items such as supermarket bags are made from polymers. This item explores why technology moves forward with the development of materials focusing on the very wide range of uses that polymers have, including health care, in the 21st century. Issues of disposal of polymers are also considered.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Activity interpreting information and researching personal interests in the context of why technology moves forward with the development of materials precisely matched to need (using a variety of contexts to capture different interests (CDs, sports equipment, health contexts etc).	Interpret simple information about properties of polymers (plastics) and their uses given appropriate information (no recall expected).
Data-search about waterproof clothing e.g. using appropriate ICT.	State uses to show how polymers (plastics) are used in packaging and clothing: • polythene or poly(ethene) is used for plastic bags; • polystyrene is used for damage protection in packaging and for insulation; • nylon and polyester in clothing. State one advantage of waterproof clothing. State one advantage of breathable clothing.
See Dorothy Warren books (RSC).	Describe many polymers as non-biodegradable, so they will not decay or decompose by bacterial action. Describe some of the ways that waste polymers can be disposed of: • use of land fill sites; • burning of waste polymers; • recycling. Describe some of the problems of using non-biodegradable polymers: • litter and difficult to dispose.
Can-Do Tasks There are no Can-Do Tasks for this section.	

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1e Making Polymers

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Suggest the properties a polymer (plastic) should have in order to be used for a particular purpose. Explain why a polymer (plastic) is suitable for a particular use given the properties of the polymer.	Describe that the atoms in plastics are held together by strong covalent bonds. Relate the properties of plastics to simple models of their structure: • plastics that have weak intermolecular forces between polymer molecules have low melting points and can be stretched easily as the polymer molecules can slide over one another; • plastics that have strong forces between the polymer molecules (covalent bonds or cross-linking bridges) have high melting points, cannot be stretched and are rigid.
Compare the properties of nylon and Gore-Tex®: • nylon is tough, lightweight, keeps water out, keeps UV light out but does not let water vapour through it which means that sweat condenses; • Gore-Tex® has all of the properties of nylon but is also breathable. Explain why the discovery of Gore-Tex® type materials has been of great help to active outdoor people to cope with perspiration wetness.	Describe the construction of Gore-Tex® type materials explaining why they make clothing waterproof and yet breathable: • nylon laminated with PTFE/polyurethane membrane; • holes in PTFE are too small for water to pass through but are big enough for water vapour to pass through; • PTFE laminate is too fragile on its own and so is combined with nylon.
Explain why chemists are developing addition polymers that are biodegradable. Explain some of the environmental and economic issues related to the use of polymers: • landfill sites get filled quickly wasting valuable land; • burning waste plastics makes toxic gases; • disposal by burning or land-fill sites wastes a valuable resource; • difficult to sort out different polymers so recycling is difficult.	

MODULE C1: CARBON CHEMISTRY

Item C1g: Using carbon fuels

Summary: This item develops ideas about fuels and the factors that need to be considered when choosing a fuel that is fit for purpose. It also considers the process of combustion.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Discuss fuels for a purpose (e.g. choosing the right fuel for heating / lighting a remote house in Scotland, powering a car, use in an electricity generating station).	Interpret data about fuels in order to choose the best fuel for a particular purpose (no recall expected).
	State that the combustion or burning of a fuel requires oxygen. State that the combustion of a fuel releases useful heat energy. State that complete combustion needs a plentiful supply of oxygen (air). State that complete combustion of a hydrocarbon fuel makes only carbon dioxide and water.
Carry out an experiment to show that combustion of a hydrocarbon in a plentiful supply of air produces carbon dioxide and water. Design a poster warning about the dangers of carbon monoxide poisoning e.g. using appropriate ICT software. Look at the products of complete and incomplete combustion by experiment and/or data search.	State that incomplete combustion takes place when there is a shortage of oxygen (air). Describe that a blue Bunsen flame transfers more energy than a yellow flame. State that a yellow flame produces lots of soot. Know that incomplete combustion of a hydrocarbon fuel makes carbon monoxide, carbon (soot) and oxygen. State that carbon monoxide is a poisonous gas.

Can-Do Tasks

I can carry out an experiment to show that combustion of a hydrocarbon in a plentiful supply of air produces carbon dioxide and water. 3 points

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1d Making Crude Oil Useful, C1h Energy, C2f Clean Air and C6a Energy Transfers – Fuel Cells

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
List factors that need to be considered in a given use of a fossil fuel: • energy value; • availability; • storage; • cost; • toxicity; • pollution e.g. acid rain, greenhouse effect; • ease of use. Interpret data about fuels in order to choose the best fuel for a particular purpose (no recall expected).	Evaluate the use (no recall expected) of different fossil fuels: • energy value; • availability; • storage; • cost; • toxicity; • pollution e.g. acid rain, greenhouse effect; • ease of use. Explain why the amount of fossil fuels being burnt is increasing.
Describe a fuel as a substance that reacts with oxygen to release useful energy. Describe an experiment to show that combustion of a hydrocarbon in a plentiful supply of air produces carbon dioxide and water. Write word equations to show the incomplete or complete combustion of a hydrocarbon fuel.	Construct the balanced symbol equation for the complete combustion of a simple hydrocarbon fuel given its molecular formula.
Explain that a blue flame releases more energy than a yellow flame because it involves complete combustion rather than incomplete combustion. Describe the advantages of complete combustion over incomplete combustion of hydrocarbon fuels: • less soot made; • more heat released; • poisonous carbon monoxide not produced. Explain the importance of regularly servicing gas appliances.	Construct the balanced symbol equation for the incomplete combustion of a simple hydrocarbon fuel given its molecular formula.

MODULE C1: CARBON CHEMISTRY

Item C1h: Energy

Summary: This item allows young people to develop ideas about how energy can be released from fuels through burning. The amount of energy released is also covered.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out experiments to find out about exothermic and endothermic reactions (with the option of using data loggers).	Recognise that chemical reactions can be used to heat things, to make light, sound and electricity. Recognise that energy can be given out or taken in during a chemical reaction. Recognise that an energy change has taken place by using temperature changes.
Compare the energy output from a blue and from a yellow Bunsen flame. Measure the energy released per gram during the combustion of butane and the combustion of some liquid fuels – possible use of spreadsheets to analyse results.	State that energy is measured in joules or kilojoules and temperature in ^{o}C. Label the apparatus needed to compare the energy output of liquid or gaseous fuels. Interpret and use data from simple calorimetric experiments related to the combustion of fuels: • calculating temperature changes; • comparing which fuel releases the most energy (mass of water used constant).

Can-Do Tasks	
I can accurately measure the temperature in ^{o}C.	1 point
I can measure the mass of an object using an electronic balance.	1 point
I can do an experiment to find the energy output per gram of a liquid fuel.	3 points

MODULE C1: CARBON CHEMISTRY

Links to other modules: C1g Using Carbon Fuels, C6a Energy Transfers – Fuel Cells, P1a Heating Houses, P1b Keeping Homes Warm

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe an exothermic reaction as one in which energy is transferred into the surroundings (releases energy). Describe an endothermic reaction as one in which energy is taken from the surroundings (absorbs energy). Recognise exothermic and endothermic reactions using temperature changes.	Describe bond making as an exothermic process. Describe bond breaking as an endothermic process. Explain why a reaction is exothermic or endothermic using the energy changes that occur during bond breaking and bond making.
Describe, using a diagram, a simple calorimetric method for comparing the energy transferred in combustion reactions: • use of spirit burner or a bottled gas burner; • heating water in a copper calorimeter; • measuring the temperature change; • fair tests. Interpret and use data from simple calorimetric experiments related to the combustion of fuel to compare which fuel releases the most energy.	Describe a simple calorimetric method for comparing the energy transferred per gram of fuel combusted: • use of spirit burner or a bottled gas burner; • heating water in a copper calorimeter; • measuring mass of fuel burnt; • measuring temperature change; • fair and reliable tests. Calculate the energy transferred by recalling and using the formula: energy transferred (in J) = mass of water heated (in g) x 4.2 x temperature (in ^{o}C) Calculate the energy output of a fuel in J/g by recalling and using the formula: energy per gram = energy supplied ÷ mass of fuel burnt

MODULE P1: ENERGY FOR THE HOME

Item P1a: Heating Houses

Summary: When a body is heated, it gets hotter. A common misconception is that heat and temperature are the same thing. This item develops ideas to show that heat and temperature are different and that heat gain or loss does not always result in a temperature rise. Water needs lots of energy to increase its temperature. It also stores lots of energy and so is useful for transporting and transferring energy around homes.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Carry out an experiment holding a lump of ice to explain why the ice melts and why the hand holding it gets cold. Examine thermograms to see where hot spots occur.	Recognise that hot objects have high temperatures and tend to cool down. Recognise that cold objects have low temperatures and tend to warm up. Recognise that for warm bodies the higher the temperature the quicker they cool. State that temperature is measured in ^{o}C. State that energy (heat) is measured in J.
Carry out an experiment to measure the energy required to change the temperature of different bodies by different amounts.	Apply knowledge that the energy needed to change the temperature of a body depends on: • mass; • the material it is made from; • the temperature change. Plan an experiment to measure the energy required to change the temperature of a body.
Show that energy is needed to change state by placing a small piece of chocolate on the tongue and allowing it to melt.	State that energy is needed to melt or boil things. Interpret data which shows that there is no temperature change when materials are: • boiling; • melting or freezing.

Can-Do Tasks	
I can accurately measure temperature in ^{o}C.	1 point
I can use a thermogram to identify areas of different temperature.	2 points
I can carry out an experiment to find out the energy needed to melt ice.	3 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules P1b Keeping Homes Warm, P1c How Insulation Works, C1h Stable Earth

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Recognise energy flow from a hot body to a cooler one. This will cause hotter bodies to cool and cooler bodies to warm. Recall that temperature is a measurement of hotness. Recall that heat is a measurement of energy.	Explain that temperature can be represented by a range of colours in a thermogram. Describe temperature as a measurement of hotness on a chosen scale. Describe heat as a measurement of energy on an absolute scale.
Recognise that the specific heat capacity of materials is: • a measure of how much energy they can hold; • the energy needed to raise the temperature of 1kg by 1^{o}C; • different for different materials.	State and use the equation: energy = mass x specific heat capacity x temperature change. (A change of subject may be required).
Describe how, even though energy is still being transferred, there is no temperature change when materials are: • boiling; • melting or freezing. Recognise that the specific latent heat of materials is: • a measure of how much energy is needed to melt or boil them; • the energy needed to melt or boil 1kg of them; • different for different materials and states.	State and use the equation: energy = mass x specific latent heat. (A change of subject may be required.) Explain that energy supplied during a change of state is used to break inter-molecular bonds and this explains why temperature does not change.

MODULE P1: ENERGY FOR THE HOME

Item P1b: Keeping homes warm

Summary: A poorly insulated home means that heat is being lost to the outside environment and more energy is being used to do this. Not only are energy resources being used up but the homeowner is also paying to heat the street. This item develops ideas about using energy efficiently and reducing energy losses from homes.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine thermograms showing where energy is lost from poorly insulated houses and from well insulated houses. Examine data showing percentage of energy lost from different areas of a poorly insulated house and from a well insulated house. Survey fuel costs in the local area. Survey to compare the effectiveness for different building materials using information from the internet and builders' merchants.	Recognise everyday examples of energy saving methods in the home. Recognise good and bad conductors. Recognise that curtains reduce energy loss through windows. Recognise that many insulation materials contain air. Apply the fact that air is a very good insulator to its use in keeping homes warm: • fibreglass or mineral wool is used as loft insulation; • double glazing in windows; • cavity-wall insulation foam; • reflective foil in or on walls; • draught-proofing.

Can-Do Tasks

I can use secondary sources, e.g. the internet, to compare the effectiveness of different insulating methods of different combinations of insulation materials. 2 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules P1a Heating Houses, P1c How Insulation Works, C1h Energy

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Interpret data and calculate cost savings of different energy saving strategies: • payback time. State and use the equation: efficiency = useful energy output / total energy input	Explain in the context of the home the concepts of conduction, convection and radiation (absorption and emission) in terms of: • the design features of the home; • the design and use of everyday appliances in the home; • energy saving strategies. State and use the equation: efficiency = useful energy output / total energy input (A change of subject is required.)

MODULE P1: ENERGY FOR THE HOME

Item: P1c How insulation works

Summary: The term insulation is used in the wider context of energy saving techniques in the home. This item develops ideas about the mechanisms of energy transfer by conduction, convection and radiation.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Use data logger to carry out an experiment to test the relative performance of different insulating materials.	State that air in a material is a very good insulator.
Use data logger to carry out an experiment to test the transfer of energy through single, double and triple glazed windows.	Recognise that hot air rises and is replaced by falling colder air.
Use data logger to carry out an experiment to test the reflection of energy from a silvered surface.	Recognise that infrared energy can be reflected from a shiny surface.
Use data logger to carry out an experiment to test the absorption of energy by a blackened dull surface.	

Can-Do Tasks

I can design a demonstration to show a convection current.	1 point
I can plot an accurate line graph of a cooling curve.	2 points
I can carry out an experiment to compare the performance of different insulating materials.	3 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules: P1a Heating Houses, P1b Keeping Homes Warm

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain in domestic situations, how energy transfer can be reduced in terms of: • conduction; • convection; • radiation.	Describe how energy is transferred by: • conduction - transfer of KE between particles; • convection - change of density causes (bulk) fluid flow; • radiation – infrared radiation needs no medium. Explain that, unless air is trapped in foam, there will still be energy loss by convection in a cavity wall.

MODULE P1: ENERGY FOR THE HOME

Item P1d: Cooking with waves

Summary: All radiation in the electromagnetic spectrum can be dangerous. Infrared radiation and microwaves heat things. This item develops ideas about infrared radiation and microwaves and examines the dangers and uses.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine household objects that work by infrared radiation e.g. iron (does not glow red) toaster (does glow red).	Interpret information on the electromagnetic spectrum to include microwaves and infrared radiation. Recognise that warm and hot objects emit radiation: • hotter objects emit more radiation; • black dull objects emit more radiation. Recognise that infrared radiation is absorbed by the surface of an object causing an increase in temperature: • black surfaces are good absorbers of radiation. Recognise that microwaves cause heating when absorbed by water and this is the basis of the
Carry out an experiment to show that a mobile phone emits radiation by causing interference with a radio signal. Interpret given information about the use and safety of mobile phone technology, e.g. using internet search. Survey opinions about the positioning of mobile phone masts.	State that mobile phones use microwave signals. Describe some concerns about children using mobile phones.

Can-Do Tasks

I can accurately measure the temperature in ^{o}C.	1 point
I can use a thermogram to identify areas of different temperature.	2 points
I can present a balanced argument in favour of or against the positioning of a mobile phone mast.	3 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules: C1a Cooking, P1e Infrared Signals, P1f Wireless Signals, P5f Nature of Waves

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe properties of microwaves: • penetrate (about 1cm) into food; • are reflected by metal; • can cause burns when absorbed by body tissue; • go through glass and plastics. Describe properties of infrared radiation: • heats the surface of the food; • is reflected by shiny surfaces.	Explain how microwaves and infrared transfer energy to materials: • microwaves absorbed by water particles in outside layers increasing their KE; • infrared is absorbed by all particles on the surface increasing their KE; • energy transferred to centre of food by conduction or convection. Describe how the energy associated with microwaves and infrared depend on their frequency and relate this to their potential danger.
Recognise that microwaves are used to transmit information over large distances that are in "line of sight" • some areas and places have poor signals. Recognise that there may or may not be dangers: • to residents near to the site of a mast; • to users of mobile phones.	Describe how diffraction and interference of microwaves can cause signal loss: • limited distance between transmitters; • high positioning of transmitters; • nuisance of obstacles affecting signals.

MODULE P1: ENERGY FOR THE HOME

Item P1e: Infrared signals

Summary: Infrared radiation is not just useful for cooking and heating. It is used by remote controls to make life easier, whether it is changing channels on the television or opening the garage doors when we get home on a cold, wet evening. This item considers how we use infrared radiation.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine the properties of infrared radiation by e.g. reflecting the beam from a remote control to a television and showing it to be absorbed.	Describe uses of infrared radiation: • in remote controls (TV, video, DVD,) automatic doors: • short distance data links for computer or mobile phones/
Examine passive infrared sensor and images captured by infrared cameras.	State that infrared sensors detect body heat and are used for: • burglar alarms; • security lights.
Examine waveforms of analogue and digital signals using an oscilloscope.	State the two types of signal used to transmit data: • analogue; • digital.
Show that lengths of optical fibre and a pencil torch can make a model of a fibre optic lamp. Show that infrared radiation can be transmitted along a length of optical fibre. Show that optical fibres can transmit a signal from tape recorder or CD player to an amplifier (and loudspeaker) or to send a program from one computer to another.	Recognise, in the context of optical fibres, when Total Internal Reflection (TIR) happens. • glass-air, water-air or perspex-air boundary. Recognise and describe how light and infrared radiation can both travel along an optical fibre from one end to another by reflection.

Can-Do Tasks	
I can draw a ray diagram to show the path of a ray of light along an optical fibre.	1 point
I can identify analogue and digital signals on equipment.	1 point
I can find the critical angle of glass / Perspex.	3 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules: P1d Cooking with Waves, P5g Refraction of Waves

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the differences between analogue and digital signals: • analogue signals have a continuously variable value; • digital signals are either on (1) or off (0).	Describe advantages of using digital signals: • to allow more information to be transmitted because of multiplexing (interleaving of many digital signals on the same data line); • less interference (noise not recognised and amplified).
Describe, in the context of optical fibres, what happens to light incident on a glass-air, water-air or Perspex-air boundary below, at and above the critical angle. Describe how light and infrared radiation can both travel along an optical fibre from one end to another by Total Internal Reflection (TIR). Describe the transmission of light in optical fibres: • optical fibres allow the rapid transmission of data; • optical fibres allow the transmission of data pulses using light.	Describe the application of total internal reflection in fibre optics: • drawing and interpreting simple ray diagrams. Describe advantages of using optical fibres to allow more information to be transmitted: • multiplexing; • lack of interference.

MODULE P1: ENERGY FOR THE HOME

Item P1f: Wireless signals

Summary: Today's hi-tech world demands that people can always receive both phone calls and email. This item develops ideas about global communication and the benefits of wireless transmission and the impact of this culture on modern society

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey of use of wireless technology within the class.	Describe how radiation used for communication can be reflected. Recognise that wireless technology uses electromagnetic radiation for communication. State that wireless technology can have advantages: • available 24 hours a day; • no wiring needed; • portable and convenient.
Examine quality of radio and mobile phone reception in the area. Show that the quality of digital radio reception is superior to analogue reception.	Recognise that some radio signals are better quality than others. Interpret simple information on digital and analogue signals.

Can-Do Tasks

I can use information about transmitter location and frequencies to tune a radio. 3 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules: P5e Satellite Communication, P5g Refraction of Waves, P1d Cooking with Waves, P5f Nature of Waves

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe how radiation used for communication can be refracted. Recognise common uses of wireless technology: • radio; • mobile phones; • laptop computers.	Explain how long-distance communication depends on the reflection of waves from the Ionosphere or by being received and re-transmitted from satellites.
Recognise that radio stations with similar transmission frequencies often interfere.	Explain how the refraction and diffraction of radiation can affect communications: • refraction at the interfaces of different layers of Earth's atmosphere; • diffraction by transmission dishes results in signal loss. Explain the advantage of digital radio in terms of lack of interference.

MODULE P1: ENERGY FOR THE HOME

Item P1g: Light

Summary: The use of light as a source of digital communication, from Morse signalling to present day laser technology, has meant rapid communication is possible. This item develops ideas about communication at the speed of light.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Looking and measuring waves: • in ripple tanks; • in power-point simulations.	Identify the main features of a transverse wave: • trough and crest; • amplitude; • wavelength. Recognise that all electromagnetic waves travel at the same high speed in space.
Show that a message can be transmitted using a signal lamp.	Describe how, historically, the use of light greatly increased the speed of communication but that it requires the use of a code.
Examine the surface of a CD under a laboratory microscope and then look at images from the internet or other resource showing 10 000 x magnification.	Recall that a laser produces an narrow intense beam of light.
Can-Do Tasks I can send and receive a message in Morse code.	2 points

MODULE P1: ENERGY FOR THE HOME

Links with other modules: P4d Ultrasound

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the main features of a transverse wave: • trough and crest; • amplitude; • wavelength; • frequency as the number of waves in each second. State and use the equation: wave speed = frequency x wavelength	State and use the equation: wave speed = frequency x wavelength (A change of subject may be required.)
Describe how light was used as a means of communication: Morse code	Explain the advantages and disadvantages of using light, radio and electrical signals for communication.
	Explain that a laser produces an intense beam of light in which all of the waves are: • the same frequency; • in phase with each other. Explain how a laser beam is used in a CD player by reflection from the shiny surface: • surface contains digital information; • information in the form of a patterns of pits.

MODULE P1: ENERGY FOR THE HOME

Item P1h: Stable Earth

Summary: There is much talk of Global Warming. The incidents of skin cancer are rising, even in the UK. This item develops ideas surrounding these and other observations. It also examines how climate is being affected by natural and human activity.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Examine seismographic traces of recent earthquakes. Make a seismic trace using pen suspended from retort stand and striking the bench.	Describe earthquakes as producing shock waves which can: • cause damage; • be detected by seismometers.
Examine effects of skin cancer.	State that exposure to ultraviolet radiation can cause: • suntan; • sunburn; • skin cancer. Recognise that sun block can reduce damage caused by ultraviolet light: • high factors reduce risks more; • high factors allow longer exposure without burning.
	Describe reasons for global warming: • increased energy use; • increased CO_2; • deforestation.

Can-Do Tasks

I can calculate the time I can safely spend in the Sun from a knowledge of normal burn time and the SPF of a sun screen. 1 point

MODULE P1: ENERGY FOR THE HOME

Links with other modules: C2c Does the Earth Move? C6e Depletion of the Ozone Layer

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe that earthquakes produce shock waves, which can also travel inside the Earth. State that there are two types of seismic waves: • longitudinal p-waves travel through both solids and liquids and travel faster than s-waves; • transverse s-waves which travel through solids but not through liquids.	Describe how seismic waves transmitted through the Earth can be used to provide evidence for its structure: • p-waves travel through solid and liquid rock (i.e. all layers of the Earth); • s-waves cannot travel through liquid rock. (i.e. the outer core).
Explain how darker skins reduce cancer risk: • absorb more ultraviolet radiation; • let less ultraviolet radiation reach underlying body tissues. Interpret given information about sun protection factor (no recall is expected). Calculate how long a person can spend in the sun without burning from a knowledge of the sun protection factor.	Describe how the ozone layer protects the Earth from ultraviolet radiation and that environmental pollution from CFCs is depleting the layer.
Explain how human activity and natural phenomena both have effects on weather patterns. Dust from: • volcanoes reflect radiation from the Sun causing cooling; • factories reflect radiation from the city causing warming.	Interpret given information about climate change as a result of natural or human activity (no recall is expected).

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 C2: ROCKS AND METALS

Item C2: Fundamental chemical concepts

Summary: Throughout the study of chemistry there are a number of ideas and concepts that are fundamental. These ideas and concepts have not been put into a particular item but should permeate all the Chemistry units. They will be assessed in the context of any of the modules C1 to C6.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
These Learning Outcomes are intended to be taught throughout this specification.	Describe that in a chemical reaction reactants are changed into products. Recognise the reactants and products in a word or symbol equation. Recognise that in a chemical change no atoms are lost or made.
These Learning Outcomes are intended to be taught throughout this specification.	State the number of elements in a compound given its formula. State the number of atoms in a formula with no brackets. State the number of each different type of atom in a formula with no brackets.
These Learning Outcomes are intended to be taught throughout this specification.	Recognise whether a substance is an element or a compound from its formula.
These Learning Outcomes are intended to be taught throughout this specification.	Recognise that a molecule is made up of more than one atom joined together. Recognise that a molecular formula shows the number and type of atom in a molecule. State the number of atoms in a displayed formula. State the names of the different elements in a compound given its displayed formula. State the number of each different type of atom in a displayed formula.
These Learning Outcomes are intended to be taught throughout this specification.	State that all atoms are made up of a nucleus and electrons. State that a chemical bond holds atoms together in a compound.

MODULE C2: ROCKS AND METALS

Links to other modules: C1 to C6

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Construct word equations given the reactants and products. Construct balanced symbol equations given the formulae (no brackets) of the reactants and products. Explain that a symbol equation is balanced when the number of each type of atom is the same on both sides of an equation.	Construct balanced symbol equations given the formulae (some or all with brackets) of the reactants and products. Construct balanced symbol equations given the names of the reactants and products (limited to the learning outcomes in this specification).
State the number of atoms in a formula with brackets. State the number of each type of different atom in a formula with brackets.	Recall the formula of the following substances: • carbon dioxide, carbon monoxide, water, oxygen and hydrogen; • calcium carbonate, calcium chloride and magnesium chloride; • hydrochloric acid.
Recognise that a displayed formula shows both the atoms and the covalent bonds in a molecule. Write the molecular formula of a compound given its displayed formula.	Balance equations that use displayed formulae.
State that the nucleus of an atom is positive and the electrons negative. State there are two types of chemical bonds: • ionic between a positive ion and a negative ion; • covalent involving a shared pair of electrons.	

MODULE C2: ROCKS AND METALS

Item C2a: Paints and Pigments

Summary: Pigments, dyes and paints play an important part in our modern day lives. Our clothes, houses and our local environment are all made much more interesting and pleasing to the eye by the use of colour.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Making coloured substances by mixing together solutions e.g. 'Active Science'. Data-search via internet about paints and the ingredients in paints.	State that a pigment is a coloured substance that is used in paint. Apply data-search to show ingredients of paint: • solvent, binding medium and pigment. Describe the functions of the solvent, binding medium and pigment in a paint. State that paint is a mixture called a colloid. Describe that oil paints: • have the pigment dispersed in an oil • and often a solvent that dissolves oil
Survey some advertisement leaflets about different types of paints.	Describe that paints are used to decorate or protect surfaces.
Historical survey into the history of dyeing fabrics.	Describe that dyes are used to colour fabrics. Describe that some dyes are natural and others synthetic.
Investigating thermochromic pigments using materials e.g. material from Middlesex University Teaching Resources.	Describe that thermochromic pigments change colour when heated or cooled.
Investigating phosphorescent pigments using material e.g. material from Middlesex University Teaching Resources.	Describe that phosphorescent pigments can glow in the dark.
Can-Do Tasks	
I can make a sample of paint with thermochromic properties.	2 points
I can use a natural product to permanently dye a piece of cotton cloth.	3 points

MODULE C2: ROCKS AND METALS

Links to other modules: C1c Smells

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe paint as a colloid where the particles are mixed and dispersed with particles of a liquid but are not dissolved.	Explain that the components of a colloid will not separate because the particles are scattered or dispersed throughout the mixture and are sufficiently small they will not settle at the bottom.
Describe that many paintsare applied as a thin surface which dries when the solvent evaporates. Describe emulsion paints as water based paints.	Explain that the drying of oil paints involves oxidation of the oil by atmospheric oxygen. Interpret the uses and properties of different paints given relevant information.
Explain that the use of synthetic dyes has increased the number of colours available to colour fabrics.	
Describe some uses of thermochromic pigments: • warning of a hot cup; • use in electric kettles.	Describe and explain how thermochromic pigments can be added to acrylic paints to give even more colour changes.
Phosphorescent pigments absorb and store energy and release it as light over a period of time.	Explain that phosphorescent pigments are much safer than the alternative radioactive substances e.g. in use of ‘glow in the dark’ watches.

MODULE C2: ROCKS AND METALS

Item C2b: Construction materials

Summary: Most landscapes include buildings such as houses, factories, flats or skyscrapers. Many of these buildings are made from raw materials found in or on the Earth's surface. The removal of the raw materials and their use has an enormous impact on the environment.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Data-search about construction materials and their sources.	State the names of some construction materials: • aluminium and iron; • brick, cement, concrete and glass; • granite, limestone and marble.
Look at samples of marble, limestone and granite. Video clips of mining and quarrying.	State that some rocks are used to construct buildings: • granite, limestone and marble. Describe the environmental problems that may be caused by removing rocks from the ground: • landscape destroyed and has to be reconstructed when the mining or quarrying has finished; • quarries or mines take up land-space; • increased noise, traffic and dust.
Investigation of the decomposition of calcium carbonate.	State that limestone and marble are both forms of calcium carbonate. Describe that limestone thermally decomposes to make calcium oxide and carbon dioxide.
Investigating the strength of concrete beams.	Describe that concrete is made when cement, sand or gravel and water are mixed together and allowed to set.
Investigating the strength of concrete beams.	Describe that concrete can be reinforced, which is made by allowing the concrete to set around a steel support.

Can-Do Tasks

I can safely heat a sample of a chemical in a test tube.	1 point
I can make and test samples of concrete for their strength.	3 points

MODULE C2: ROCKS AND METALS

Links to other modules: C2c Does the Earth Move?

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that some construction materials are manufactured from rocks in the Earth's crust: • aluminium and iron from ores; • brick from clay; • glass from sand.	
Describe that marble is much harder than limestone. Describe that granite is harder than marble.	Explain why granite, marble and limestone have different hardness: • limestone is a sedimentary rock; • marble is a metamorphic rock made by the action of high pressures and temperatures on limestone; • granite is an igneous rock.
State that the word equation for the decomposition of limestone is: calcium carbonate→calcium oxide + carbon dioxide. Describe thermal decomposition as a reaction in which when heated one substance is chemically changed into at least two new substances.	State that the balanced symbol equation for the decomposition of limestone is: $CaCO_3 \rightarrow CaO + CO_2$
Describe that cement is made when limestone and clay are heated together.	
Describe reinforced concrete as a composite material containing concrete and a solid steel support.	Explain why reinforced concrete is a better construction material that non-reinforced concrete: • hardness of the concrete; • flexibility and strength of the steel.

MODULE C2: ROCKS AND METALS

Item C2c: Does the Earth Move?

Summary: We often read or hear news items on earthquakes and volcanoes. This item builds on the interest young people show towards these events. Models are used to help explain volcanic eruptions.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Create a model of the Earth's structure. Use ICT and/or other material to construct a map of where volcanoes and earthquakes occur on the Earth's surface. Model a volcano using the candle wax experiment. http://www.jesei.org	Describe the structure of the Earth as a sphere with a thin rocky crust, mantle and core. State that the Earth's core contains iron. State that the movement of tectonic plates results in volcanic activity and earthquakes.
	Describe how molten rock can find its way to the surface through weaknesses in the crust.
Look for clues contained in volcanic rocks that show how they formed. Video clips of volcano types. Treacle investigation. Salol experiment. http://www.jesei.org	State that igneous rock is made when molten rock cools down. Describe magma as molten rock beneath the surface of the Earth. Describe lava as molten rock that erupts from a volcano. State that some of the rock on the Earth's surface has been formed by volcanic activity. Describe that some volcanoes give runny lava, some give thick lava violently and catastrophically.
Look at examples of people who live near volcanoes and those who choose to study them.	Describe that some people choose to live near volcanoes because volcanic soil is very fertile.
Can-Do Tasks I can mark on a map of the world ten locations of Earthquakes or Volcanoes.	1 point

MODULE C2: ROCKS AND METALS

Links to other modules: C2b Construction Materials, P1h Stable Earth

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe the outer layer of the Earth (lithosphere) as oceanic plates under oceans and continental plates forming continents. Describe the lithosphere as the (relatively) cold rigid outer part of the Earth that includes the crust and the outer part of the mantle. Explain that tectonic plates are found on top of the mantle because they are less dense than the mantle. Explain the problems of studying the structure of the Earth.	Describe the mantle as the zone between the crust and the core and that it is relatively cold and rigid just below the crust but hot and non-rigid and so able to flow at greater depths. Describe the theory of plate tectonics: • energy transfer involving convection currents in the largely solid mantle causing the plates to move slowly; • oceanic plates are more dense than continental plates; • collision between oceanic and continental plate leads to subduction and partial re-melting (oceanic goes underneath continental). Describe in simple terms the development of the theory of plate tectonics.
Explain that magma from the mantle must have a density less than that of the crust in order to rise through it.	
Explain how the size of crystals in an igneous rock is related to the rate of cooling of molten rock: • iron-rich basalt and its coarse equivalent gabbro; • silica-rich rhyolite and its coarse equivalent granite.	State that magma can have different compositions and that this affects the rock that forms and the type of eruption, limited to: • iron-rich basalt (runny and fairly 'safe'); • explosive silica-rich rhyolite (producing pumice and volcanic ash and bombs, sometimes with graded bedding).
Describe that geologists study volcanoes to be able to predict future eruptions and to reveal information about the structure of the Earth.	Describe that geologists are now able to better predict volcanic eruptions but not with 100% certainty.

MODULE C2: ROCKS AND METALS

Item C2d: Metals and Alloys

Summary: Metallic elements and alloys have many uses in our society. This item examines how metals are extracted from their ores. It also describes some of the uses of some important alloys including smart alloys.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Extraction of copper by heating malachite and carbon. Purification of copper by electrolysis.	State that copper can be extracted by heating its ore with carbon. State that copper can be purified by electrolysis. Describe that recycling copper is cheaper than making copper and that it saves resources.
Research about alloys – their uses and composition. Data search or experimental investigation into the properties of alloys.	State that an alloy is a mixture of two elements one of which is a metal. Recognise that brass, bronze, solder, steel, and amalgam are alloys. State one important large scale use for each of the following alloys: • amalgam, brass and solder.
Internet research about smart alloys and their uses. Investigate nitinol (Middlesex University Teaching Resources).	Recognise that the properties of an alloy are different from the properties of the metals from which it is made. Interpret data about the properties of metals, including alloys e.g. hardness, density, boiling point and strength.

Can-Do Tasks

I can extract a sample of copper from a copper ore such as malachite.	2 points
I can purify a sample of impure copper using the electrolysis of aqueous copper sulphate.	2 points

MODULE C2: ROCKS AND METALS

Links to other modules: C2e Cars for Scrap, C3f Electrolysis, C3h Metal Structure and Properties, C5b Electrolysis, C6d Chemistry of Sodium Chloride (NaCl)

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Label the apparatus needed to purify copper by electrolysis. Describe some of the problems of recycling copper.	Describe the use of electrolysis in the purification of copper: • impure copper as anode; • pure copper as cathode; • copper(II) sulphate solution as electrolyte.
State the main metals in each of the following alloys: • amalgam – mercury; • brass – copper and zinc; • solder – lead and tin.	
Describe that alloys often have properties that are different from the metals they are made from and that these properties may make the alloy more useful than the pure metal. Suggest properties needed by a metal or alloy for a particular given use.	Explain why metals, including alloys are suited to a given use given appropriate data (no recall expected). Explain how the use of 'smart alloys' such as those with a shape memory property have increased the number of applications of alloys e.g. nitinol (nickel and titanium).

MODULE C2: ROCKS AND METALS

Item C2e: Cars for Scrap

Summary: Young people take the use of cars for granted. This item develops ideas about the problem of disposing of cars and the recycling of metals. Rusting and corrosion are also considered.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Investigate the corrosion of aluminium and iron using different conditions (e.g. salt water, acid rain, moist air). Comparing rate of corrosion of cars in the UK with that of Mediterranean countries.	State that rusting needs iron, water and oxygen. State that aluminium does not corrode in moist conditions. Interpret data about the rate of corrosion of different metals in different conditions (no recall is expected).
Compare the physical properties of iron and aluminium and their alloys either by data search or by experiment (density, magnetic property, electrical conductivity, flexibility, hardness and strength). Write a promotional leaflet for a car made from aluminium illustrating the advantages of such a car over one made from iron or steel.	Describe similarities and differences between the properties of iron and aluminium: • iron is more dense than aluminium; • iron is magnetic and aluminium is not; • iron corrodes (rusts) easily and aluminium does not; • iron and aluminium are both malleable; • iron and aluminium are both good electrical conductors. State that alloys are usually a mixture of two or more metals.
Research all the materials that are used to manufacture cars (e.g. plastics, fibres, glass, copper, iron, aluminium).	List the major materials needed to build a car: • steel, copper and aluminium; • glass, plastics and fibres.
Discuss the problems of disposing of cars. Visit a car scrap yard.	Describe the advantages of recycling materials: • saves natural resources; • reduces disposal problems.

Can-Do Tasks

I can distinguish, using experiments, between a sample of aluminium and iron.	1 point
I can carry out an investigation to find the optimum conditions for corrosion of a named metal.	3 points

MODULE C2: ROCKS AND METALS

Links to other modules: C2d Metals and Alloys, C3h Metal Structure and Properties, C5b Electrolysis and C6d Chemistry of Sodium Chloride (NaCl)

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State that salt water and acid rain accelerate rusting. Explain that aluminium does not corrode in moist conditions because it has a protective layer of aluminium oxide which does not flake off the surface. Interpret data about the rate of corrosion of different metals in different conditions (no recall is expected).	Describe rusting as an oxidation reaction where iron reacts with water and oxygen to form hydrated iron(III) oxide. State the word equation for rusting: iron + oxygen + water → hydrated iron(III) oxide
Describe that alloys often have properties that are different from the metals they are made from and that these properties may make the alloy more useful than the pure metal: • steel is harder and stronger than iron; • steel is less likely to corrode than iron. Describe advantages and disadvantages of building car bodies from aluminium or from steel: • car body of the same car will be lighter with aluminium; • car body with aluminium will corrode less; • car body of the same car will be more expensive made from aluminium.	Explain advantages and disadvantages of building car bodies from aluminium or from steel: • car body of the same car will be lighter with aluminium so get better fuel economy; • car body with aluminium will corrode less and so may have a longer lifetime.
Suggest properties needed by a material for a particular use in a car. Explain why a material used in a car is suited to a given use given appropriate data (no recall expected).	
Explain the advantages and disadvantages of recycling the materials used to make cars. Explain that new laws will soon specify that a minimum percentage of all materials used to manufacture cars must be recyclable.	Evaluate information on materials used to manufacture cars (no recall expected).

MODULE C2: ROCKS AND METALS

Item C2f: Clean Air

Summary: The increase in respiratory illnesses such as asthma in young people may be caused by an increase in air pollution. This item develops ideas about air pollution, its origin and how it can be prevented. The use of catalytic converters to reduce atmospheric pollution will also be considered.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Experimental determination the composition of clean air.	State that air contains oxygen, nitrogen, water vapour and carbon dioxide. Recognise that oxygen, nitrogen and carbon dioxide levels in the atmosphere are approximately constant. Recognise that photosynthesis decreases the level of carbon dioxide and increases the level of oxygen in the air. Recognise that respiration and combustion increase the level of carbon dioxide and decrease the level of oxygen in the air.
Research the increase in occurrences of asthma in the UK and possible links with air pollution e.g. from the internet. Write a leaflet describing the main forms of atmospheric pollution, their effects and origins.	Relate the common pollutants found in air to the environmental problem the pollutant causes: • carbon monoxide – a poisonous gas; • oxides of nitrogen – photochemical smog and acid rain; • sulfur dioxide – acid rain that will kill plants, kill aquatic life, erode stonework and corrode metals.
Research the methods of preventing atmospheric pollution.	State that a catalytic converter removes carbon monoxide from the exhaust gases of a motor car.
Can-Do Tasks There are no Can-Do tasks for this section.	

MODULE C2: ROCKS AND METALS

Links to other modules: C1g Using Carbon Fuels, C6e Depletion of the Ozone Layer

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State the percentage composition by volume of clean air: • 21% oxygen; • 78% nitrogen; • 0.035% carbon dioxide. Describe a simple carbon cycle involving photosynthesis, respiration and combustion. Describe how the present day atmosphere evolved: • original atmosphere came from gases escaping from the interior of the Earth; • photosynthesis by plants increases the percentage of oxygen until it reached today's level.	Evaluate the effects of human influences on the composition of air: • deforestation; • increased energy consumption (burning of fossil fuels); • population. Describe one possible theory for how the atmosphere evolved: • degassing from the Earth's crust; • initial atmosphere of ammonia and carbon dioxide; • formation of water; • development of photosynthetic organisms; • increase in oxygen and nitrogen levels; • lack of reactivity of nitrogen.
Describe the origin of the following atmospheric pollutants: • carbon monoxide – incomplete combustion of petrol or diesel in car engine; • oxides of nitrogen – formed in the internal combustion engine; • sulfur dioxide – formed when sulfur impurities in fossil fuels burn. Interpret data about the effects of atmospheric pollutants.	
Explain why it is important that atmospheric pollution is controlled. State that a catalytic converter changes carbon monoxide into carbon dioxide.	Describe the use of a catalytic converter in removing carbon monoxide from exhaust fumes by converting it to carbon dioxide: $2CO + 2NO \rightarrow N_2 + 2CO_2$

MODULE C2: ROCKS AND METALS

Item C2g: Faster or Slower (1)

Summary: Explosions are impressive examples of very fast reactions. This item develops the ideas of rate of reaction including collision frequency. The effect of changing temperature and concentration are considered by means of practical work.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Video clips of fires, rusting and explosions to illustrate different rates of reaction.	Recognise that some reactions can be fast and others very slow: • rusting is a slow reaction; • burning and explosions are very fast reaction.
ICT simulations involving collisions between particles.	Recognise that a chemical reaction takes place when particles collide.
Investigate the rate of reaction using magnesium ribbon or calcium carbonate and dilute hydrochloric acid.	State that the rate of a chemical reaction can be increased by increasing the temperature (or vice versa).
Investigate the rate of reaction using magnesium ribbon or calcium carbonate and dilute hydrochloric acid.	State that the rate of a chemical reaction can be increased by increasing the concentration (or vice versa). State that the rate of a gas phase reaction can be increased by increasing the pressure (or vice versa).
Investigate the rate of reaction using magnesium ribbon or calcium carbonate and dilute hydrochloric acid using gas syringe to collect gas. Look at the application of rate of reaction in everyday life (e.g. speed of cooking with pressure cooker, slowing up rusting, rate of dissolving tablets for medicinal use).	Interpret data in table, graphical and written form involving the effect of temperature and concentration on the rate of reaction e.g. • reading off values from a graph; • recognising the fastest reaction by comparing gradients of graphs; • recognising the shortest reaction time and hence the fastest reaction. Explain that a reaction stops when one of the reactants is all used up. Label the laboratory apparatus needed to measure the rate of reaction (including a gas syringe).
Can-Do Task I can measure the rate of a reaction that produces a gas.	3 points

MODULE C2: ROCKS AND METALS

Links to other modules: C2h Faster or Slower (2), C5e Gas Volumes, C5f Equilibria

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Explain that the more collisions between particles the faster the reaction.	Explain that the rate of reaction depends on the: • collision frequency of reacting particles; • energy transferred during the collision (whether the collision is successful or effective).
Explain that a temperature increase makes particles move faster so they have more energy, and that this gives an increased rate of reaction (and vice versa).	Explain that an increase in temperature results in more effective, successful or energetic collisions (and vice versa).
Explain that increasing the concentration (or pressure) increases the rate of a reaction because the particles are more crowded (and vice-versa).	Explain that increasing the concentration (or pressure) increases the rate of a reaction by increasing the frequency of collisions between particles (and vice versa).
Interpret data in table, graphical and written form involving the effect of concentration and temperature on the rate of reaction e.g: • deciding when a reaction has finished; • comparing the rate of reaction during a reaction; • deciding when the rate of reaction is the greatest. Explain that the amount of product formed depends on the amount of reactant used. Draw sketch graphs to show the effect of changing temperature or concentration on: • rate of reaction; • amount of product formed in a reaction.	Interpret data from table, graphical and written form involving temperature and concentration on the rate of reaction e.g: • calculating the rate of reaction from the slope of an appropriate graph; • extrapolation; • interpolation.

MODULE C2: ROCKS AND METALS

Item C2h: Faster or Slower (2)

Summary: Explosions are impressive examples of very fast reactions. This item develops the ideas of rate of reaction including collision frequency. The effect of changing surface area and catalysts on the rate of reaction are considered by means of practical work.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Class practical to investigate catalysis using hydrogen peroxide and metal oxide catalysts or zinc and dilute hydrochloric acid with a variety of possible catalysts including copper and copper compounds.	State that the rate of a reaction can be increased by the addition of a catalyst.
Investigate surface area using magnesium powder and ribbon with acid or marble chips or powder with acid.	State that the rate of a reaction can be increased by using powdered reactant rather than a lump (or vice versa).
Watch a video on flour/lycopodium explosions. Video clips of other explosions e.g. knocking down a building , explosion in a quarry.	List examples of explosions: • burning hydrogen; • custard powder; • TNT or dynamite explosion.
Look at the application of rate of reaction in everyday life (e.g. resin and hardener in a car body filler, catalytic converters, rate of dissolving tablets for medicinal use).	Interpret data in table, graphical and written form involving the effect of surface area and the addition of a catalyst on the rate of reaction e.g: • reading off values from a graph; • recognising the fastest reaction by comparing gradients of graphs; • recognising the shortest reaction time and hence the fastest reaction.

Can-Do Tasks	
I can investigate a reaction to find a suitable catalyst.	3 points
I can measure the volume of a gas produced in a reaction using a gas syringe.	1 point
I can measure the reaction time for a suitable reaction.	1 point
I can use experimental results such as volume of gas produced against time to determine the rate of reaction.	3 points
I can measure the volume of a liquid using a measuring cylinder.	1 point

MODULE C2: ROCKS AND METALS

Links to other modules: C2g Faster or Slower (1), C4d Making Ammonia – Haber Process and Costs and C5e Gas Volumes, C5f Equilibria

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe a catalyst as a substance which changes the rate of reaction and is unchanged at the end of the reaction. State that only a small amount of a catalyst is needed to catalyse large amounts of reactants.	Recognise that a catalyst is specific to a particular reaction.
Explain that a powder has a larger surface area than a lump and so reacts faster because there are more collisions.	Explain that an increase in surface area increases the frequency of collisions.
Describe an explosion as a very fast reaction which releases a large volume of gaseous products. Explain the dangers of fine combustible powders in factories (e.g. custard powder, flour or sulfur).	
Interpret data in table, graphical and written form involving the effect of surface area and the addition of a catalyst on the rate of reaction: • deciding when a reaction has finished; • comparing the rate of reaction during a reaction; • deciding when the rate of reaction is the greatest. Draw sketch graphs to show the effect of changing surface area and the addition of a catalyst on the: • rate of reaction; • amount of product formed in a reaction.	Interpret data from table, graphical and written form involving surface area and the addition of a catalyst on the rate of reaction: • calculating the rate of reaction from the slope of an appropriate graph; • extrapolation; • interpolation.

MODULE P2: LIVING FOR THE FUTURE

Item: P2a Collecting Energy from the Sun

Summary: The Sun has supplied our planet with energy for a long time. This item shows how solar energy can be used, in a sustainable way, to provide us with some of our energy needs.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Investigate how the voltage and current from a photocell varies with distance from the light source. Research the use of photocells for providing electricity in remote locations. Investigate how the power of a photocell depends on its surface area. Investigate how photocells can be connected to increase their voltage.	Describe that the Sun: • is a stable source of energy; • transfers energy to Earth as light and heat. Describe that photocells: • transfer light into electricity; • produce direct current (DC); • can operate in remote locations; • have a power that depends on the surface area exposed to sunlight.
Build a solar collector from aluminium foil and an umbrella. Investigate a model greenhouse. Survey the use of passive solar heating of buildings. Survey the distribution of wind turbines in the UK.	Describe other ways that the Sun's energy can be harnessed: • light can be absorbed by a surface and transferred into heat energy; • produce convection currents (wind) to drive turbines. Describe that the Sun is a renewable source of energy.

Can-Do Tasks	
I can use a voltmeter to measure voltage.	1 point
I can accurately measure temperature in ^{o}C.	1 point
I can carry out an investigation to find out how the voltage produced by a photocell varies with distance from a light source.	3 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P3e Energy on the Move

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe that DC electricity is current in the same direction all the time. Describe some advantages and disadvantages of using photocells to provide electricity: • low maintenance; • no need for power cables; • no need for fuel; • long life; • rugged; • renewable energy resource; • no polluting waste; • no power at night or bad weather.	Describe how light produces electricity in a photocell: • energy absorbed by photocell; • electrons are knocked loose from the silicon atoms in the crystal; • electrons flow freely. Describe how the power of a photocell depends on: • light intensity; • surface area exposed.
Describe other ways that the Sun's energy can be harnessed: • how glass can be used to provide passive solar heating for buildings; • light can be reflected to a focus by a curved mirror; • transfer KE of air to electricity in wind turbines.	Explain why passive solar heating works: • glass is transparent to sun's radiation; • heated surfaces emit infrared; • glass reflects infrared; An efficient solar collector must track the position of the Sun in the sky. Describe the advantages and disadvantages of wind turbines: • renewable; • rugged; • no polluting waste; • visual pollution; • dependency on wind speed; • space needed.

MODULE P2: LIVING FOR THE FUTURE

Item P2b: Generating Electricity

Summary: Most of our electricity is generated in power stations by burning fuels. This item shows how power stations work and how energy is transported to our homes and factories.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Build a model generator with magnets and coils to produce electricity. Examine the difference between a model generator and the generator in a power station. Examine ways in which the current of a generator can be increased. Examine the output of a generator with an oscilloscope.	Describe and recognise the dynamo effect: • electricity can be generated by moving a coil near a magnet; • moving a magnet near a coil. Describe that a generator produces alternating current (AC). Describe that a battery produces direct current (DC).
Find out about the construction of power stations. Demonstrate a steam engine transferring chemical energy of a fuel into kinetic energy.	Describe the main stages in the production and distribution of electricity: • source of energy; • power station produces electricity; • national grid of power lines connecting station to consumers; • consumers are homes, factories, offices and farms. Describe that some of the energy of the fuel in a power station is wasted as heat energy in the environment.
Find out about the national grid. Demonstrate a model transmission line system with resistance wires and a pair of transformers.	Recognise that transformers can be used to: • increase or decrease voltage.

Can-Do Tasks

I can use an oscilloscope to measure the maximum voltage of AC.	2 points
I can use an oscilloscope to measure the frequency of AC.	3 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P2c Fuels for Power P4h Fission P6d Generating

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe and recognise the dynamo effect can be increased (more current): • stronger magnets; • more turns; • faster movement. Describe and interpret AC using a voltage-time graph.	Describe that the frequency of AC electricity is the number of cycles per second.
Describe how simple AC generators work. • coil of wire; • magnetic field; • coil and field close; • relative motion between coil and field. Describe how electricity is generated at a conventional power station: • burning fuel; • producing steam; • spinning a turbine; • turbine turns generator. Describe and recognise that there is significant waste of energy in a conventional power station.	Use these equations in the context of a power station to calculate energy input, energy output, waste energy output and efficiency. • fuel energy input = waste energy output + electrical energy output; • efficiency = $\frac{\text{electrical energy output}}{\text{fuel energy input}}$ To include change of subject.
Explain how transformers are used in the National grid: • electricity is transmitted at high voltage to reduce energy waste and costs.	Explain how for a given power transmission, increased voltage reduces current, so decreasing energy waste by reducing heating of cables.

MODULE P2: LIVING FOR THE FUTURE

Item P2c: Fuels for Power

Summary: The heat energy for our power stations comes from a variety of sources. This unit considers the economic and environmental costs of the different sources we use today.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Measure the energy released by a fossil fuel by using a candle to heat water. Build a model digester to generate methane from biomass. Use software to find out how a nuclear power station operates.	Describe that the common fuels (energy sources) used in power stations: • fossil fuels – are crude oil, coal, natural gas; • renewable biomass - wood, straw, manure; • nuclear fuel.
Examine the use of an electricity meter or joule-meter to measure energy transfer. Find out about the cost of electricity at different times of the day. Find out about the power of different electrical appliances. Survey the efficiency rating of fridges, freezers and light bulbs.	Describe that the unit of power is the watt or kilowatt: Interpret data to show the cost of using electrical appliances depends on; • power rating in watts and kilowatts; • the length of time it is switched on.
Find out about the evidence for global warming in the last 200 years. Discuss the possible consequences of global warming. Discuss the advantages and disadvantages of using fossil fuels for making electricity.	Describe that waste from nuclear power is radioactive: • can be harmful; • does not give rise to global warming.

Can-Do Tasks

I can read a domestic electricity meter.	1 point
I can use meter readings to calculate the cost of using electricity.	2 points
I can find the energy transferred in an electrical circuit using an ammeter, voltmeter and a timer.	3 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P2b Generating Electricity, P2d Nuclear Radiations P4h Fission, C1d Make Crude Oil Useful

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe that: • burning fuels releases energy as heat; • uranium fuel rods release energy as heat; • biomass can be fermented to generate methane.	Describe and evaluate the advantages and disadvantages of different energy sources.
Calculate the power rating of an appliance using the equation: power = voltage × current State that the unit of electrical energy supplied is the kilowatt hour. Calculate the number of kilowatt hours given the: • power in kilowatts; • time in hours. Calculate the cost of energy supplied.	State, be able to use and manipulate the equation: power = voltage × current Use the kilowatt hour as a measure of the energy supplied. State and use the equation: energy supplied = power x time to calculate: • power in kW or W; • time in hours and / or minutes; Describe the advantages and disadvantage of using off-peak electricity in the home.
Recall that ionising radiations (from radioactive waste) can cause cancer. Recall that uranium is a non-renewable resource. Recall that plutonium. • is a waste product from nuclear reactors; • can be used to make nuclear bombs.	Describe the advantages and disadvantages of nuclear power: • decommissioning costs; • pollution from fuel processing; • risk of accidental emission of radioactive material; • high maintenance costs; • independence from fossil fuels; • high stocks of fuel; • no greenhouse gases.

MODULE P2: LIVING FOR THE FUTURE

Item P2d: Nuclear Radiations

Summary: Most people know that radioactivity can be dangerous, but do not understand why. This item develops ideas about the uses of radioactivity, the nature of ionising radiations and how to handle their sources safely.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
	Describe and recognise that nuclear radiation can be beneficial or harmful: • state one example of a beneficial use; • harmful effect: damages living cells.
Teacher to use radiation detectors to show the ionising properties of nuclear radiation. Show the differing ranges and penetrating power of alpha, beta and gamma radiation.	State and recognise the three types of nuclear radiation: • alpha; • beta; • gamma. Describe and recognise that there is background radiation in the environment which is always present.
Demonstrate the safety measures to be taken when handling radioactive sources. Do a survey to find out how radioactive waste from nuclear power stations is disposed of.	Describe how to handle radioactive materials safely: • protective clothing; • tongs / keep your distance; • short exposure time; • shielded and labelled storage.
Can-Do Tasks I can describe how to handle radioactive sources safely.	2 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P2c Fuels for Power, P4e Treatment, P4f What is radioactivity P4g Use of Radioisotopes

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe examples of beneficial uses of radiation: • alpha - smoke detectors; • beta - tracers and paper thickness gauges; • gamma - treating cancer, non-destructive testing and sterilising equipment. Describe that radioactive materials give out nuclear radiation.	
Describe the relative penetrating power of alpha, beta and gamma. State that nuclear radiation ionises materials. Describe that ionisation produces charged particles. Describe background radiation and state that it is caused by radioactive substances, rocks, soil, living things and cosmic rays.	Describe how alpha, beta and gamma can be identified by their penetrating power. Explain ionisation in terms of: • removal of electrons from particles; • gain of electrons by particles.
Describe some ways of disposing radioactive waste e.g. • low level waste in land-fill sites; • encased in glass and left underground; • reprocessed.	Explain the problems of dealing with radioactive waste: • remains radioactive for a long time; • terrorist risk; • must be kept out of groundwater; • acceptable radioactivity level may change over time.

MODULE P2: LIVING FOR THE FUTURE

Item P2e: Our Magnetic Field

Summary: The magnetic field around our planet shields us from a lot of ionising radiation from the rest of the Universe. This field and our existence may be due to an unlikely series of events long ago. Earth may be a very special place because of its large moon.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey the sources of background radiation. Use a GM tube to record background radiation. Demonstrate the deflection of beta particles by a magnetic field. Demonstration by Teltron Tubes.	Describe that: • the Earth is surrounded by a magnetic field; • magnets have a north and south pole; • the Earth's core contains a lot of molten iron; • a plotting compass shows the direction of a magnetic field; • cosmic rays are ionising radiations from space.
Use a compass to investigate the magnetic field around a current-carrying coil.	Describe that electrical current (moving electrical charges) in a coil creates a magnetic field.
Discuss the evidence for the presence of the Moon as the result of a collision between the Earth and another planet.	Describe that the Moon may be the remains of a planet which collided with the Earth.
Survey the various uses of satellites around the Earth. Survey the electricity and communications blackouts caused by solar flares.	Describe that the Sun: • is a source of ionising radiation; • causes solar flares that can interfere with the operation of artificial satellites; State the uses of artificial satellites; • Telecommunications; • weather prediction; • spying; • (satellite) navigation systems.

Can-Do Tasks

I can use a compass to find the direction of a magnetic field.	1 point
I can use a plotting compass to map the magnetic field around a coil or magnet.	2 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P4e Treatment, P4f What is Radioactivity? P4g Uses of Radioisotopes, P5a Satellites, Gravity and Circular Motion, P6c Motors, P6d Generating

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe: • the shape of the Earth's magnetic field; • that charged particles are deflected by magnetic fields.	Describe that cosmic rays: • are fast moving particles which create gamma rays when they hit the atmosphere; • spiral around the Earth's magnetic field to the poles; • cause the Aurora Borealis.
Describe the shape of the magnetic field around a current-carrying coil (direction of field from current not required).	Describe that magnetic fields can be generated by moving charged particles.
Describe how a collision between two planets can result in an Earth-Moon system: • the planets collide; • their iron cores merge to form the Earth; • less dense material orbits as the Moon.	Discuss the evidence for the Earth-Moon system as the result of a collision between two planets.
Describe the nature solar flares: • clouds of charged particles from the Sun; • ejected at high speed; • produce strong disturbed magnetic fields.	Describe the consequences of a solar flare arriving at the Earth: • satellite communications; • electricity distribution.

MODULE P2: LIVING FOR THE FUTURE

Item P2f: Exploring our Solar System

Summary: When we look at the night sky, we can sometimes see the Moon, artificial satellites, planets in our Solar System and the billions of stars which make up the Universe. This item discusses the problems involved in visiting other parts of the Solar System.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Build a scale model of the Solar System and then work out where the nearest star would be on the same scale. You are a travel agent. Produce a brochure for aliens who might visit our Solar System.	State and recognise that: • Earth is one of a number of planets that orbit the Sun; • the moon orbits Earth; • Earth orbits the Sun. State and recognise that the universe consists of: • stars and planets; • comets and meteors; • black holes • large groups of stars called galaxies. Describe that stars can be seen even though they are far away because they are: • very hot; • give off their own light.
Survey the exploration of the Moon by the Apollo missions. Discuss the problems of manned space travel. Design a manned mission to Mars.	Describe that radio signals take a long time to travel through the solar system. Explain that manned spacecraft need to take food, water and oxygen.
Survey the exploration of our Solar System by robot spacecraft. Suggest reasons why we might need to explore our Solar System. Debate the advantages and disadvantages of using robot spacecraft to explore the Solar System.	Explain that unmanned spacecraft (probes) do not need food, water or oxygen.

Can-Do Tasks

I can use ICT to produce a labelled model of our Solar System.	1 point
I can use data on sizes and distances to design a model of our solar system to fit inside the laboratory or onto school grounds.	3 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P2g Threats to Earth

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
State and recognise the relative positions of Earth. Sun and planets (includes the order of the planets). Describe that gravitational force determines the motion of planets and satellites.	State the relative positions of planets, stars, comets, meteors, galaxies and black holes. State and recognise that circular motion requires a centripetal force. State and recognise that gravity provides the centripetal force for orbital motion.
Describe some of the difficulties of manned space travel between planets: • enough fuel; • long time required; • effect of low gravity on health; • shielding from cosmic rays; • maintaining a stable atmosphere; • providing enough food and water; • keeping warm.	Describe that a light-year is: • a measurement of very large distances; • the distance light travels in a year.
Recall that unmanned spacecraft can withstand conditions that are lethal to humans. State that unmanned spacecraft can send back information on: • temperature, magnetic field and radiation; • gravity, atmosphere and surroundings.	Explain the advantages and disadvantages of using unmanned spacecraft to explore the Solar System: • costs; • safety; • reliability; • maintenance.

MODULE P2: LIVING FOR THE FUTURE

Item P2g: Threats to Earth

Summary: Most people ignore the threat of asteroid collision to the Earth. This item shows that the threat is real and has proved to be lethal many times in the past. Strategies for avoiding such catastrophes are outlined.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Survey the evidence for the destruction of the dinosaurs by an asteroid. Discuss how the surface of the Moon provides evidence for the continual bombardment of the Earth by asteroids.	State that large asteroids have collided with the Earth in the past. State that asteroids are rocks. Describe some of the consequences of a collision with a large asteroid: • crater; • ejection of hot rocks; • widespread fires; • sunlight blocked by dust; • climate change; • species extinction.
Survey the history of Halley's comet. Survey the exploration of comets by robot spacecraft. Discuss the collision of a comet with Jupiter.	Describe that the tail of a comet is a trail of debris.
Debate the importance of funding telescopes to search for Near Earth Objects. Design a plan to deal with the threat of an asteroid collision.	Describe a Near Earth object (NEO) as an asteroid or comet on a possible collision course with Earth. Describe how Near Earth Objects may be seen with telescopes.
Can-Do Tasks I can make a telescope from a pair of lenses.	2 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules: P2f Exploring our Solar System

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe that asteroids: • are left over from the formation of the Solar System; • orbit between Mars and Jupiter. Describe some of the evidence for past asteroid collisions: • craters; • layers of unusual elements in rocks; • sudden changes of fossil numbers between adjacent layers of rock;	Explain why the asteroid belt is between Mars and Jupiter: • the large gravity of Jupiter disrupts the formation of a planet.
Describe that comets: • have highly elliptical orbits; • are made from ice and dust; • come from objects orbiting the Sun far beyond the planets. Describe that the speed of a comet increases as it approaches a star.	Explain why the speed of a comet increases as it approaches a star: • the strength of gravity increases.
Describe that observations of Near Earth objects (NEO) can be used to determine their trajectories.	Suggest and discuss possible actions which could be taken to reduce the threat of Near Earth objects (NEO): • surveys by telescope; • monitoring by satellites; • deflection by explosions.

MODULE P2: LIVING FOR THE FUTURE

Item P2h: The Big Bang

Summary: There are a number of theories about how the Universe was formed and how it will continue to evolve. This item develops ideas about the evolution of the Universe and its possible future. The Big Bang theory is considered.

Suggested activities and experiences to select from	Assessable learning outcomes Foundation Tier only: low demand
Identify examples of the Doppler effect e.g. passing police siren, whirling a buzzer round on a string. Doppler simulations on PowerPoint. Build a model of the expanding Universe with a balloon to show that spots on the surface are moving faster and further away from each other as the balloon is inflated. Draw a time line for the age of the Universe. Discuss ideas about the origin of the Universe.	Describe some ideas about the Big Bang theory for the origin of the Universe; • started with an explosion; • the Universe is still expanding.
Demonstrate heating by compression with a fire piston. Discuss ideas about the birth and death of stars. Survey the evidence for the Black Hole at the centre of the Milky Way.	Describe that stars: • have a finite 'life'; • start as a huge gas cloud. Describe that not even light can escape from a black hole.

Can-Do Tasks

I can use ICT to find out about the stages of a star's life cycle and put the stages in the correct order.

2 points

MODULE P2: LIVING FOR THE FUTURE

Links with other modules:

Assessable learning outcomes both tiers: standard demand	Assessable learning outcomes Higher Tier only: high demand
Describe that: • all galaxies are moving away from us; • distant galaxies are moving away more quickly; • microwave radiation is received from all parts of the universe.	Explain how the Big Bang theory accounts for: • light from galaxies is shifted to the red end of the spectrum; • the further away galaxies are, the greater the red shift; • the age and starting point of the Universe.
Describe the end of a medium-weight star like our Sun: • red giant; • planetary nebula; • white dwarf. Describe the end of a heavy-weight star: • red giant; • supernova; • neutron star or black hole.	Describe the life history of a star: • interstellar gas cloud; • gravitational collapse producing a proto-star; • thermonuclear fusion; • long period of normal life (main sequence); • end depends on mass of star; Explain the properties of a black hole: • large mass; • large gravity; • not even light can escape.

4 Scheme of Assessment

4.1 Units of Assessment

GCSE Science B (J640)	
Unit 1: Science B Unit 1 – modules B1, C1, P1 (B621)	
33⅓% of the total GCSE marks 60 minutes written paper 60 marks	This question paper: • is offered in Foundation and Higher Tiers; • focuses on modules B1, C1 and P1; • uses structured questions throughout (there is no choice of questions).
Unit 2: Science B Unit 2 – modules B2, C2, P2 (B622)	
33⅓% of the total GCSE marks 60 minutes written paper 60 marks	This question paper: • is offered in Foundation and Higher Tiers; • focuses on modules B2, C2 and P2; • uses structured questions throughout (there is no choice of questions).
Unit 3: Science B Unit 3 – 'Can-Do' tasks and report on 'Science in the News' (B625)	
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)

4.2 Unit Options

There are no unit options within this specification.

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 B621 and B622, candidates are entered for an option in either the Foundation Tier or the Higher Tier. Unit B625 (skills assessment) is not tiered.

Candidates may enter for either the Foundation Tier or Higher Tier in each of the externally assessed units. So, a candidate may take, for example B621/F and B622/H.

4.4 Assessment Availability

	B621	B622	B625
January 2007	✓	✓	–
June 2007	✓	✓	✓

After June 2007, Units B621 and B622 will be available in both the January and June sessions. The skills assessment, Unit B625, 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 Science in the News report.

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

Can-Do tasks provide opportunities to demonstrate practical capabilities and explore the ways in which scientific evidence is collected.

The report on **Science in the News** aims to motivate candidates and give them an insight into how science is reported to the public, the validity of underlying research and claims or recommendations made based on the research.

Introduction to Skills Assessment

The portfolio of work done during the course (for Unit B625) accounts for one third of the marks for this specification. Portfolio work is assessed by teachers, internally standardised and then externally moderated.

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.

Summary of the Elements of Unit 3 (B625)

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	6 marks	20% overall
	B Analysis of the data	6 marks	
	C Evaluation of the data	6 marks	
	D Relating the data to the issues	6 marks	
	E Justifying a conclusion	6 marks	
	F Quality of written communication	6 marks	
	Total max mark = 36 marks		

5.2 Marking Internally Assessed Work

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 is 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.

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 judgments 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.

Recording and Submitting Marks for Internally Assessed Work

The final total mark for element 1 and element 2 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.

When submitting a candidate's work for moderation the Can-Do task record form should be used as a wrapper for the assessed Science in the News report. The front of this form should be completed to show the candidate's overall performance.

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 B621 and B622 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 both units. Candidates may, if they wish, attempt 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	
B621	F	01	Science B Unit 1 – modules B1, C1, P1 Foundation
	H	02	Science B Unit 1 – modules B1, C1, P1 Higher
B622	F	01	Science B Unit 2 – modules B2, C2, P2 Foundation
	H	02	Science B Unit 2 – modules B2, C2, P2 Higher
B625	-	01	Science B Unit 3 – 'Can do' tasks and report on Science in the News

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 **J640** 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, (entries made within the usual time or within a specified period after publication of results) or at a later session.

First certification will be available in June 2007 and every January and June thereafter.

Certification cannot be declined.

6.3 Grading

GCSE results are awarded on the scale A* to 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 and 3	100-90	89-80	79-70	69-60	59-50	49-40	39-30	29-20	19-0

Higher tier candidates who fail to gain a 'd' grade may achieve an "allowed e". Higher tier candidates who miss the allowed grade 'e' will be 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 Science 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 Science 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 1310.

7 Other Specification Issues

7.1 Overlap with other Qualifications

This specification has been developed alongside GCSE Additional Science, GCSE Biology, 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 (Level 1) or Intermediate Level (Level 2), for example OCR GCSE Additional Science, OCR GCSE Applied Science (Double Award), OCR GCSE 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 Additional Science, OCR GCSE Applied Science (Double Award), OCR Additional Applied Science.

To proceed to appropriate qualifications in the sciences at Advanced Level (Level 3), in addition to this GCSE Science course, candidates should also study a course leading to a qualification in GCSE Additional Science or GCSE Additional Applied Science or one of the separate sciences (GCSE Biology, GCSE Chemistry, GCSE Physics.

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, B1d, B1e, B2e, B2h, C1b, C1f, C2a, P1b, P2a.
Datalogging	Internal assessment. B1a, B1f, B2a, C1h, C2g, P1c.
Processing data	Internal assessment. B1a, B1d, B2a, C1h, P1c.
Visualisation	Internal assessment. C1e, C2c, C2g, P2c, P2h.
Making presentations	Internal assessment. B1e, B1f, C1a, C1g, C2f, P1d, P2c, P2f.

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, C1d, C2a.
The rights and responsibilities of consumers, employers and employees	C1b, C1c.
The issues and challenges of global interdependence and responsibility, including sustainable development and Local Agenda 21	P2a, P2c.
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. B1b, B1e, B1f, C1f, C2f, P2a.
Expressing, justifying and defending orally and in writing a personal opinion about a topical scientific issue.	Internal assessment. B1e, B1h, C1c, C2f, P1d.
Contributing to group and class discussions	There will be opportunities for discussion in every module. Here are some specific examples. B1c, B1e, B1h, C1b, P2f, P2g.
Section 3: Developing Skills of participation and responsible action.	
Consider and evaluate views that are not their own	Internal assessment. B1e, B2h, C1c, P2a.
Participating in science-based school and community activities.	B2d, C2e, P1g.

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 unit.

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, P2g, P2h.
Risk and the factors which decide the level of risk people are willing to accept in different circumstances.	B1c, C2h, P1h, P2d.
The range of factors which have to be considered when weighing the costs and benefits of scientific activity.	Internal assessment. P1d, P2a.
The ethical implications of selected scientific issues.	B1b, B1h, B2h, C1c, C1d.
Scientific explanations which give insight into human nature.	
Scientific explanations which give insight into the local and global environment	Internal assessment. B2a, B2g, B2h, C2c.
Scientific explanations which give insight into our planet and its place in the Universe	B2a, B2f, P2f, P2g, P2h.

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, C1g, C2f, P2c.
Natural disasters and how to predict them	C2c, P2g.
Food and agriculture	B2h, C1b.
Origins and management of waste materials	B2g, C1f, C2e, P2c, P2d.
Energy resources	C1d, P1b, P1c, P1d, P2a, P2c.
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, B2f, C2f, P1h, P2d.
Food and nutrition	B1b, C1a, C1b
Living with radiation.	B1h, P1d, P2d.

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	C2b
Environmental issues which extend over a larger area than the UK	B1b, B2f, B2h, C1d, C2b, P2b, P2c.
Differences in attitudes to key issues in different parts of Europe	B1e, C2e.

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, histrograms

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 (^{o}C); kelvin (K)
current	ampere (A); milliampere (mA)
voltage	volt (V); millivolt (mV)

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

Hazards, 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.

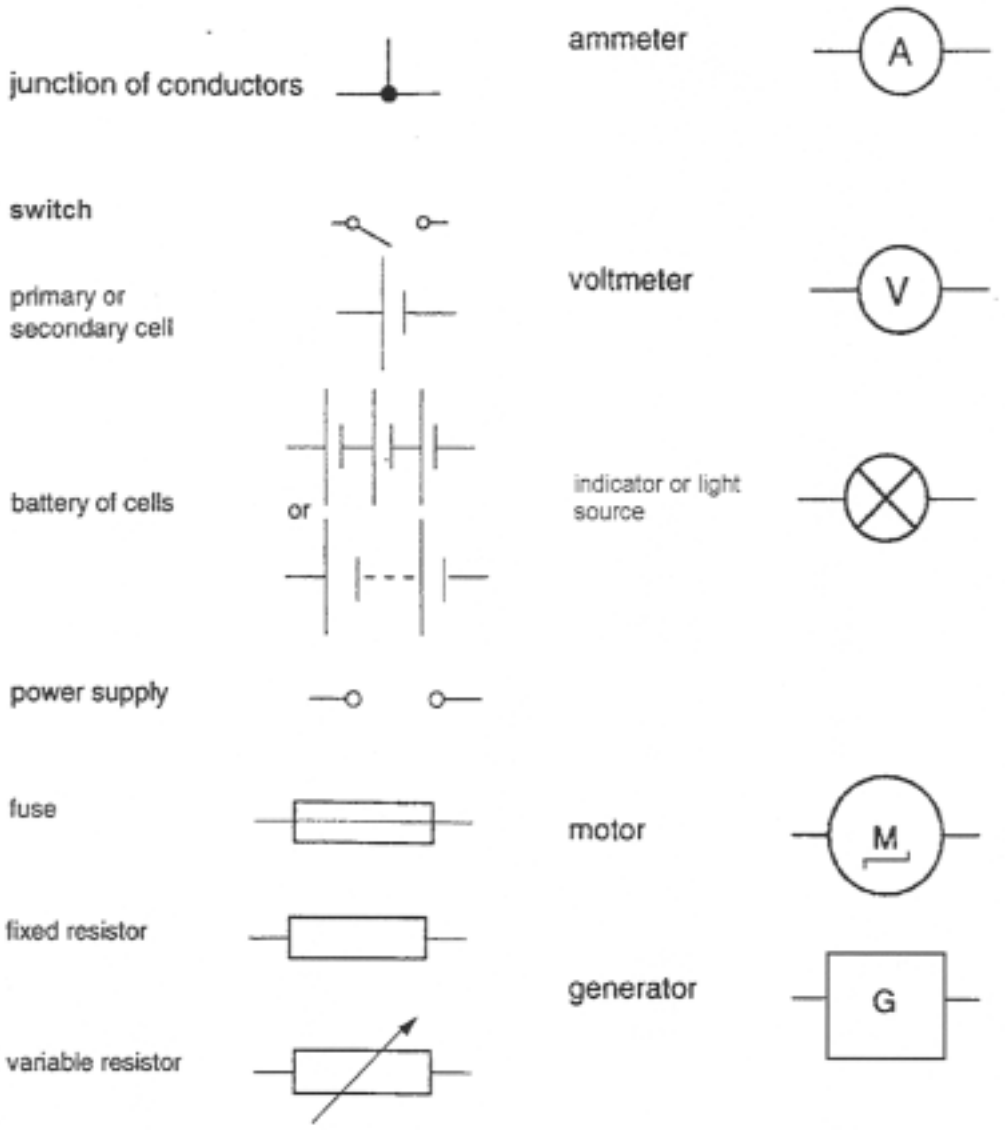
Where an employer has adopted these or other publications as the basis of their model risk assessments, an individual Centre then has to review them, to see if there is a need to modify or adapt them in some way to suit the particular conditions of the establishment. Such adaptations might include a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

Appendix E: Electrical Symbols



Appendix F: Periodic Table

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.
The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number