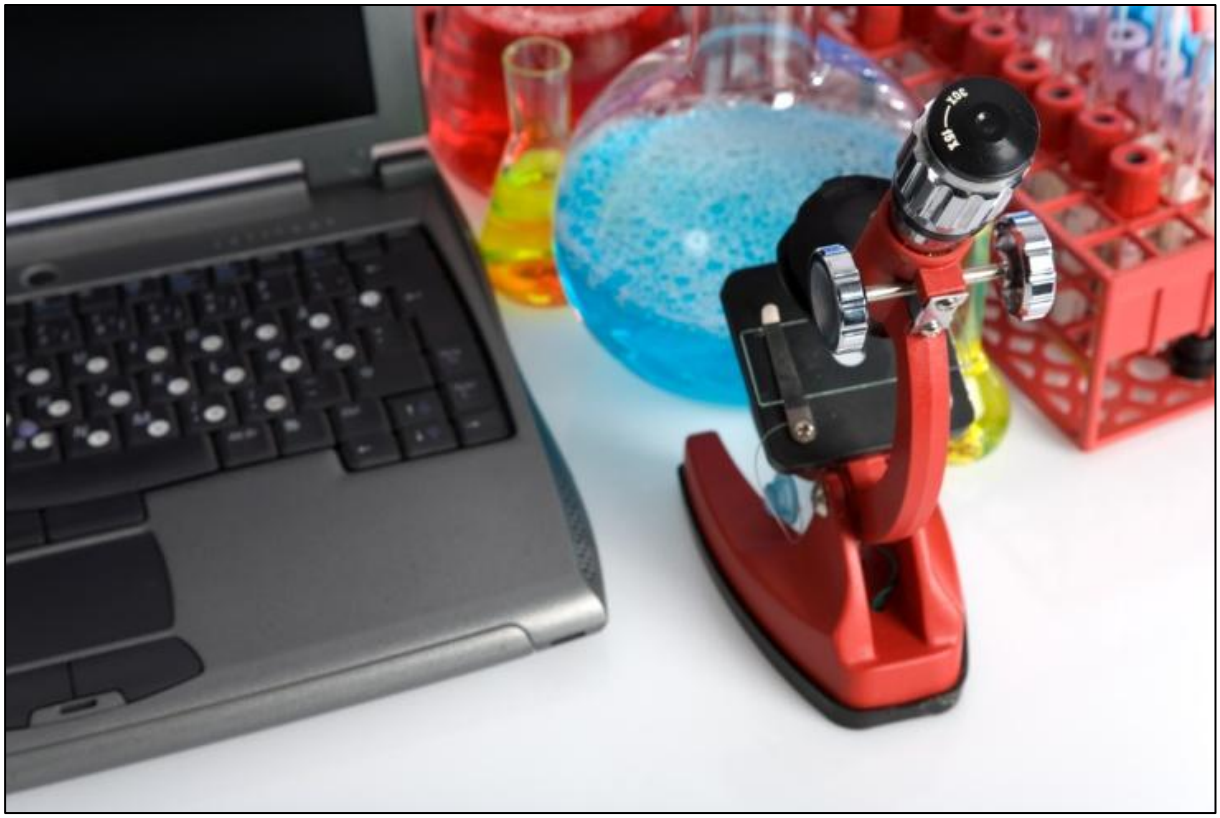
Course Support Notes

National 4 Science Course Support Notes



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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

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Contents

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the National 4 Science Course. They are intended for teachers and lecturers who are delivering the Course and its Units. They should be read in conjunction with the *Course Specification*, the *Added Value Unit Specification* and the *Unit Specifications* for the Units in the Course.

General guidance on the Course

Aims

As stated in the *Course Specification*, the aims of the Course are to enable learners to:

- develop and apply knowledge and understanding of science
- develop an understanding of science's role in scientific issues and relevant applications of science in society and the environment
- develop scientific inquiry and investigative skills
- develop scientific analytical thinking skills in a science context
- develop the use of technology, equipment and materials, safely, in practical scientific activities
- develop problem solving skills in a science context
- use and understand scientific literacy, in everyday contexts, to communicate ideas and issues
- develop the knowledge and skills for more advanced learning in science

Progression into this Course

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- Science (National 3) Course or relevant component Units

There may also be progression from National 3 Biology, National 3 Chemistry, National 3 Environmental Science or National 3 Physics Courses.

Experiences and outcomes

National Courses have been designed to draw on and build on the curriculum experiences and outcomes as appropriate. Qualifications developed for the senior phase of secondary education are benchmarked against SCQF levels. SCQF level 4 and the curriculum level 4 are broadly equivalent in terms of level of demand although qualifications at SCQF level 4 will be more specific to allow for more specialist study of subjects.

Learners who have completed relevant Curriculum for Excellence experiences and outcomes will find these an appropriate basis for doing the Course. In this Course, learners would benefit from having experience of the following:

Organisers	**Lines of development**	
Planet Earth	Biodiversity and interdependence	SCN 03
	Energy sources and sustainability	SCN 04
	Processes of the planet	SCN 05
Forces, Electricity and Waves	Electricity	SCN 10

Materials	Properties and uses of substances	SCN 15, SCN 16
	Earth's materials	SCN 17
	Chemical changes	SCN 18, SCN 19

More detail is contained in the Science Progression Framework.
The Science Progression Framework shows the development of the key areas throughout the suite of Courses.

Skills, knowledge and understanding covered in the Course

Note: teachers and lecturers should refer to the *Added Value Unit Specification* for mandatory information about the skills, knowledge and understanding to be covered in this Course.

Progression from this Course

This Course or its components may provide progression to:

- National 4 or 5 Course in another science subject
- Skills for Work Courses (SCQF levels 4 or 5)
- National Certificate Group Awards
- National Progression Awards (SCQF levels 4 or 5)
- employment

Hierarchies

Hierarchy is the term used to describe Courses and Units which form a structured sequence involving two or more SCQF levels.

It is important that any content in a Course and/or Unit at one particular SCQF level is not repeated if a learner progresses to the next level of the hierarchy. The skills and knowledge should be able to be applied to new content and contexts to enrich the learning experience. This is for centres to manage.

- Science Courses from National 3 to National 4
- Courses from National 3 to National 4 have Units with the same structure and titles.

Approaches to learning and teaching

The purpose of this section is to provide you with advice and guidance on learning and teaching. It is essential that you are familiar with the mandatory information within the Science *Added Value Unit Specification*.

Teaching should involve an appropriate range of approaches to develop knowledge and understanding and skills for learning, life and work. This can be integrated into a related sequence of activities, centred on an idea, theme or application of science based on appropriate contexts, and need not be restricted to the Unit structure. Learning should be experiential, active, challenging and enjoyable, and include appropriate practical experiments/activities and could be learner-led. The use of a variety of active learning approaches is encouraged, including peer teaching and assessment, individual and group presentations, role-playing and game-based learning, with learner-generated questions.

When developing your Science Course there should be opportunities for learners to take responsibility for their learning. Learning and teaching should build on learners' prior knowledge, skills and experiences. The Units and the concepts identified within them may be approached in any appropriate sequence, at the centre's discretion. The distribution of time between the various Units is a matter for professional judgement and is entirely at the discretion of the centre. Each Unit is likely to require an approximately equal time allocation, although this may depend on the learners' prior learning in the different key areas.

Learning and teaching, within a class, can be organised, in a flexible way, to allow a range of learners' needs to be met, including learners achieving at different levels. The hierarchical nature of the new Science qualifications provides improved continuity between the levels. Centres can, therefore, organise learning and teaching strategies in ways appropriate for their learners.

Within a class, there may be learners capable of achieving at a higher level in some aspects of the Course. Where possible, they should be given the opportunity to do so. There may also be learners who are struggling to achieve in all aspects of the Course, and may only achieve at the lower level in some areas.

Teachers/lecturers need to consider the Course and Unit Specifications, to identify the differences between Course levels. It may also be useful to refer to the Science Progression Framework.

When delivering this Course to a group of learners, with some working towards different levels, it may be useful for teachers to identify activities covering common concepts and skills for all learners, and additional activities required for some learners. In some aspects of the Course, the difference between levels is defined in terms of a higher level of skill.

An investigatory approach is encouraged in Science, with learners actively involved in developing their skills, knowledge and understanding by investigating a range of relevant Science applications and issues. A holistic approach should be adopted to encourage simultaneous development of learners' conceptual understanding and skills.

Where appropriate, investigative work/experiments, in Science, should allow candidates the opportunity to select activities and/or carry out extended study. Investigative and experimental work is part of the scientific method of working and can fulfil a number of educational purposes.

All learning and teaching should offer opportunities for learners to work collaboratively. Practical activities and investigative work can offer opportunities for group work, which should be encouraged. Group work approaches can be used within Units and across Courses where it is helpful to simulate real-life situations, share tasks and promote team working skills. However, there must be clear evidence for each learner to show that the learner has met the required assessment standards for the Unit or Course.

Laboratory work should include the use of technology and equipment that reflects current scientific use. Fieldwork provides an opportunity for practical work, using first-hand experience of an ecosystem to develop knowledge, understanding and problem solving. Appropriate risk assessment must be undertaken.

Learners would be expected to contribute their own time, in addition to programmed learning time.

Effective partnership working can enhance the science experience. Where possible, locally relevant contexts should be studied, with visits where this is possible. Guest speakers from eg industry, further and higher education could be used to bring the world of science into the classroom.

Information and Communications Technology (ICT) can make a significant contribution to practical work in Science, in addition to the use of computers as a learning tool. Computer interfacing equipment can detect and record small changes in variables allowing experimental results to be recorded over short periods of time completing experiments in class time. Results can also be displayed in real time helping to improve understanding. Data logging equipment and video cameras can be set up to record data and make observations, over periods of time longer than a class lesson, which can then be subsequently downloaded and viewed for analysis.

Learning about Scotland and Scottish culture will enrich the learners' learning experience and help them to develop the skills for learning, life and work they will need to prepare them for taking their place in a diverse, inclusive and participative Scotland and beyond. Where there are opportunities to contextualise approaches to learning and teaching to Scottish contexts, teachers and lecturers should consider this.

Assessment should be integral to and improve learning and teaching. The approach should involve learners and provide supportive feedback. Self- and peer-assessment techniques should be encouraged, wherever appropriate. Assessment information should be used to set learning targets and next steps.

Suggestions for possible contexts and learning activities, to support and enrich learning and teaching, are detailed in the table below.

The key areas are from the **Added Value Unit Specification**. **Suggested contexts** and activities in the **Suggested learning activities** are not mandatory. This offers examples of suggested activities, from which you could select a range of suitable activities. It is not expected that all will be covered. The contexts for **Mandatory Course Key Areas** are open to personalisation and choice, so centres may also devise their own learning activities.

Risk assessment should always be carried out by teachers/lecturers prior to doing any of the experiments and demonstrations listed in the table.

Fragile Earth		
In this Unit there are opportunities for personalisation and choice. Learners will focus on two choices from the following four: ♦ energy ♦ food ♦ metals ♦ water They will investigate these resources through activities related to their source, origin, production and/or extraction. Uses and benefits will be explored. Conflicts and also possible local, national, or global solutions will be identified. Learners will gain knowledge of how science is involved in environmental issues.		
Fragile Earth — Energy		
Key areas	**Suggested contexts**	**Suggested learning activities and exemplified key areas**
For one renewable and one non-renewable source, investigate and compare: ♦ source/origin, production and/or extraction ♦ use (as appropriate) ♦ conflicts, benefits and issues	You live in a small town on the coast. The nearest big city is about 75 miles away. Most people in your town work in agriculture and fishing, but the population is growing and communication with the outside world via internet and telephone is essential. At the moment, electricity is supplied via individual generators in people's homes, which need diesel transported to the town by road. The generators are unreliable and break down often. The town also regularly runs out of fuel as the roads are unusable during the rainy season. Some of the wealthier homes have solar panels which	Activities are themed around a context and are designed to allow learners to answer the questions posed through practical experiments and web-based research. The Energy Quest Room is a comprehensive Californian website which covers all the necessary content. Additional web resources are given for each relevant activity. **Introduction** Suggested content: Energy is needed for transport, heating, cooking, lighting, ICT, sport, leisure and healthcare. Electricity, gas and oil are the main domestic energy sources,

Possible solutions could be local, national or global	provide a backup when the generator breaks down. The town council have decided to provide a central source of energy to provide power to the growing population. You are a member of the town council — what would be your choice of energy for this town? Use the information available and the results from your experiments to help you reach a decision. *Thinking through the problem* The council need to consult the locals as some money will be required to fund the new system. At the first public meeting, a fight breaks out among the residents. Here are some of the things they say: What's wrong with the generators? Mine works fine!	but are produced from a mixture of renewable and non-renewable sources. c.f. Energy Quest Room **Suggested activities** Keep a logbook of a whole day or whole week's activities, noting down the type of energy source used: electrical, gas, wind, etc for each activity. Do a class survey of the main energy source for heating, lighting and cooking in each home. Draw a bar graph of results. An additional useful web resource is provided by Parsel University in Denmark: 'How to heat my house?' Introduce the questions asked by the council members about each type of energy source. Each question can be reviewed after the chosen experiments and activities have been completed. **Suggested content** Electricity, gas and oil are the main domestic energy sources, but are produced from a mixture of renewable and non-renewable sources. Finite energy sources are limited and will run out one day. Coal, oil, gas and nuclear fuel are all examples of the main finite (non-renewable) fuel sources. Renewable energy sources are those which will not run out, ie can be replaced or regrown. The production of ethanol from sugar cane is a renewable fuel source. cf: Energy Quest Room **Suggested activities** Experiment — How much energy can we get from fossil fuels like diesel? Measure the heat produced when diesel (or a synthetic substitute) is burned and compare it with the heat produced from burning ethanol. Simple temperature changes in a given mass of water can be used.

		Experiment — Would ethanol be easier to get than diesel? Ferment sugar (or locally grown fruit or potatoes) to produce ethanol. **Suggested content** Renewable energy sources are those which will not run out, ie can be replaced or regrown. Wind power, solar power, hydroelectric, biofuels, geothermal energy, tidal and wave power are all examples of renewable energy sources. Experiment — How efficient are solar panels? Use solar cells to power a light bulb, LED, toy car and fan. Compare the effectiveness of the solar cell with a conventional alkaline battery. Solar buggy kits are available from the Natural History Museum. EPSRC and the University of Edinburgh have some useful online resources available as part of their Renewable Energy Roadshow. Experiment — Build your own solar cell Build a homemade solar cell. The Solar Spark provides a recipe and some extra information on this. Try different dyes from fruit or food colouring to see which make the best cell.
	I've spent a fortune on my solar panel! Why should I have to pay for a new system? Everyone should buy their own! If we build a power plant, it will cause pollution and our fish and plants will die.	**Suggested content** Fossil fuels like coal, oil and gas produce acidic gases when they are burned. These acidic gases can lead to the loss of plant and aquatic life. **Suggested activities** Experiment — Burn sulphur and carbon in oxygen to show that acid rain is produced. Show a video or animation on the formation of acid rain from sulphur and nitrogen oxides. The United States EPA website and the *Times Educational Supplement* online database are good resources for these animations.

	We should use our new energy plant to sell power to the next town down the coast. Maybe they will sell us some of their hilly land to put up a windfarm?	Prepare a poster, PowerPoint or report. What are the main advantages of renewable fuels over coal- or gas-powered stations? What are the disadvantages? What would learners choose as a possible solution? Visit a power station if one is available locally. **Suggested content** There are losses incurred whenever electricity is transmitted, and good infrastructure is necessary to do it efficiently. High voltage, low current transmission is necessary to avoid high losses. **Suggested activities** Experiment — Set up a model transmission line for electricity. Compare the losses using a DC and AC current and changing the voltage. NB learners do not need to understand the concept of a transformer for this, just that infrastructure for high voltage transmission is necessary for efficient transmission. Experiments 352 and 423 on the Practical Physics website may be used to illustrate/investigate these losses. **Suggested content** vi) Wind power, solar power, hydroelectric, biofuels, geothermal energy, tidal and wave power are all examples of renewable energy sources. **Suggested activities** Experiment — Build a wind turbine or use the school wind turbine to measure the power available and plot a table to show which types of devices could be powered by different numbers or sizes of individual wind turbines. cf: EPSRC/University of Edinburgh Renewable Energy Roadshow Make a visit to a local windfarm to find out what the advantages are in running a large scale operation.

	What proposal will you make to council?	**Consolidation activity** Learners can choose one renewable and one non-renewable source of energy from the ones they have investigated, and produce a media item summarising what they have learned about these sources (eg PowerPoint, poster, video, animation, poem, newspaper article etc). Comparisons between the two might include sustainability, cost, practicality etc.

Fragile Earth — Metals		
Key areas	**Suggested contexts**	**Suggested learning activities and exemplified key areas**
For two different metals, one commercially used on a large scale and one commercially used on a small scale, investigate and compare: ♦ source/origin, production and/or extraction ♦ use (as appropriate) ♦ conflicts, benefits and issues Possible solutions: one from a local, national or global context.		Investigate: conductivity (thermal and electrical), density, strength, malleability and ductility of at least two metals. Also metals are sonorous. Compare the properties of metals with non-metals. Compare physical and chemical properties of different metals. **Resources** Interactive world map to investigate metal abundance, availability and cost. Education Scotland Some internet resources: ♦ Science videos on RSC website will provide an illustrative background to metal properties and uses. ♦ From the TES website you can download various teacher and learner resources that will revise the properties and use of metals already covered in the level 4 outcomes covered in S1 to S3 ♦ Metal uses in pigments and in colour. This practical application of why metals are so useful can be used in the introduction to this topic. ♦ You can use the Practical Chemistry website and show 'Flame colours — a demonstration'. This is an experiment with flame tests and explains why we see colours in metal pigments and fireworks. There were some articles in *New Scientist* magazine about the low abundance and difficulty of extraction of metals used in touch screens for phones and computers. These can be accessed from the *New Scientist* website and could be used by the teacher to set the scene to research metal uses and abundance for this context.

	Mobile metals of the future **Who** has got the metal that **you** need: Centre chooses an application that they can research (the mobile phone, computer, solar cell, electric cars etc.) Scenario It is the 22nd century. We are running out of metals for communications and renewable energies. In an independent or post-recession Scotland (fictional future scenario of your choice) we need more metals for solar panels, optical cables and computer hard drives (these are rare earth metals 'Rare earth' is an alternative name for the lanthanides — elements 57 to 71 — plus yttrium and scandium). The elements are integral to modern life, and are used in everything from disc drives, hybrid cars and sunglasses to lasers and aircraft used by the military (more information in the *New Scientist* article reference in resources column for the teacher to use in setting up the context) Can you dig the metals up in your backyard to make a mobile phone, computer hard drive, and solar panels? **Ethical resources** Unethical use of children in mining valuable and rare metals used in touch-screen computers. How can you be sure the metals in your mobile phone computer are ethically sourced?	As a scene setter for this context, *The Guardian* newspaper had articles about unethically sourced metals used to make mobile phones and laptops. The metals were mined using child slave labour in war-torn Congo. Can be used by the teacher to set the scene for researching metal abundance and some of the human costs in using these metals. **Lesson plans and class activities** about recycling mobile phones from Oxfam, for ages 12–16 can be accessed on the Oxfam website.

	Precious metals Thieves steal and resell metals as they become more valuable. Look at where metals are stolen from and the prices they can be sold for investigate how they can be protected.	These tie in with recycling valuable resources and using them to help others. To give some background to this context, there are some news articles that can be found on the Guardian website about thieves stealing metals. You could investigate why these metals are being stolen using the following questions: ♦ What are they used for and why? ♦ Why are they so valuable (the recession is making metal costs rapidly increase) ♦ How reactive are they? ♦ Are these metals always recycled? ♦ What is the cost of this? ♦ How abundant are they?
	Metals of the future New alloys can be made with different properties. For new technologies we need new materials. What metals would we use to make a flying car or a space elevator?	To give some background to this context there was an article in *New Scientist* magazine about making new alloys that are strong enough to make improved jet engines. You could investigate uses of alloys and the new properties that they give metals. Possibly design a new alloy with the class. Experiment — from the Practical Chemistry website, 'Making an alloy (solder)'. You could also use soldering to make a useful object or sculpture.
	Metal catalysts are used in many ways to make new materials or to save energy investigate some of these, where they are found and how they are used.	'Sustainability is Precious' is a series of **activities and experiments** from Johnson Matthey that explain how precious metals play a vital role in removing harmful pollutants from the air we breathe. This gives us some insights into why these metals are precious. This can be downloaded from the TES website.
	Gold on our doorstep Gold is to be mined at Cononish near Tyndrum. Work on constructing the mine first began in the	To give some background to this context, some news articles about the gold mine at Cononish near Tyndrum can be found

	1980s but low gold prices forced closure before the mine became fully operational. The mine is now viable because the price of gold has gone up. Research into the pros and cons of having this resource on our doorstep. Does it bring wealth and new jobs or irreparable environmental damage to this beautiful area?	on the Glasgow Herald and BBC websites. Some suggested activities that fit in with the context. ♦ Visit to a mine or mining museum (if available locally). ♦ Try gold panning **practical activity** (could demo this with copper powder and sand in sink). ♦ Design and make a medal for the Commonwealth Games — choose between a pure metal or alloy (research cost, availability and abundance). Some other experiments and activities to illustrate metal extraction that could be used in conjunction with the context you choose. The following two activities are from the TES website: ♦ A PowerPoint presentation that: Asks a pupil to link the special properties of titanium to specific uses (golf clubs, aircraft, piercing, and hip replacements). Links to websites with video clips showing uses and also a titanium quiz. Looks at extraction from its ore, via use of displacement reactions. ♦ A series of questions about the extraction of metals, and their properties, uses and alloys. Suitable websites are given to help students find the information, with links to a couple of short films for them to watch along the way. Also some different ways of extracting metals from their ores. ♦ Extract copper from copper chloride using electrolysis. ♦ Extraction of iron form iron(III) oxide using a match head. ♦ Extraction of copper from fake malachite ore (use a mixture of cement and copper carbonate to make fake malachite and then design an experiment to extract the copper from this). ♦ Extraction of copper from copper oxide by burning with Bunsen on a piece of burnt wood (this provides the carbon for the reduction reaction). You need to use two safety mats and cool the reduced copper oxide with water.

	Recycling metals Having gathered information during the Unit on how rare expensive and difficult to extract metals are, investigate recycling metals using some of these activities.	♦ A magnet to compare iron content in different breakfast cereals. (Link to mineral nutrients in food.) ♦ Research why the more valuable metals are more expensive to extract. ♦ Visit a local waste management site. ♦ Research local and national policy on metal recycling. ♦ School or class project on recycling metals. ♦ Make a new and useful item out of cans, bottle tops or foil wrappings. ♦ Build a sculpture with soldering skills learned in properties of metals.

Fragile Earth — Food		
Key Areas	**Suggested contexts**	**Suggested learning activities and exemplified Key Areas**
For two foods, investigate and compare: ♦ source/origin, production and/or extraction ♦ use (as appropriate) ♦ conflicts, benefits and issues Possible solutions: one from a local, national or global context	It is estimated that almost one billion people worldwide go hungry every day and at least half of all deaths of children under five are malnutrition related. The problem of food shortages affects mainly the developing world and is predicted to get worse due to a combination of factors including climate change, ecological degradation, population growth, rising energy prices, increasing demand for meat and dairy products and competition with other land uses such as the production of biofuels and urban expansion. This contrasts with the developed nations where food surpluses lead to overeating and gives rise to an alternative set of health problems such as obesity, diabetes and heart disease. In future, spiraling transport energy costs will make it prohibitively expensive to ship large amounts of food around the world. This will reduce the ability of rich countries to provide food aid for those countries that need it. The increase in fuel prices and concerns about carbon emissions will also make it less attractive to source out-of-season foods from distant parts of the world. As a result, it will be necessary to develop more sustainable ways of producing and consuming food locally. This will	**Growing plants from seeds** Collect and examine seeds from a variety of plants, eg cress, mung bean, broad beans etc. Measure water content of stored and fresh seeds (eg peas). Test seeds for starch. Grow a collection of plants from a variety of seeds (eg watercress, tomatoes, courgettes etc). Demonstrate the conditions needed for the germination of seeds. Demonstrate plant life cycle using 'fast plants'. Test plants grown under different conditions to demonstrate the factors needed for photosynthesis. Measure changes in mass of germinating seeds and photosynthesizing seedlings. Investigate sowing seeds. **Plant production** Make and use rooting and potting composts. Demonstrate the water-holding capacity of different composts. Investigate drainage of composts with different compositions. Demonstrate the importance of plant nutrients. Investigate watering of plants. Design and make a watering system for house plants which could run for a week or more. Monitor environmental conditions such as minimum and maximum temperatures, relative humidity and wind speed. Examine leaflets etc on greenhouse design, heating systems and ventilation devices. Demonstrate the use of a thermostat. Investigate the effects of sunlight, shade, artificial lighting on plant growth. Prick out seedlings sown earlier. Dead head bedding plants in the vicinity. Pot-on plants. Compare different methods of controlling pests and diseases.

	have a significant impact on food production that will see a focus on organically farmed local produce and a reduction in livestock with consequential changes in diet.	Examine leaflets on cloches and tunnels. Examine horticultural fleece. Analyse and interpret data on characteristics of selected species. Give examples of genetically engineered plants of economic importance to man. **Livestock production** Analyse and interpret data on characteristics of selected species. Give two examples of improved characteristics resulting from selective breeding. Discuss economic importance of selective breeding. Examples of uses made of various cuts. Religious/cultural influence on food processing. **Impact of technology on food production** Microbial tests for consumption safety (Resazurin test). Investigate various processing treatments for milk. Make yoghurt. Investigate different types of rennet. Make dough. Investigate factors necessary for fermentation to take place. Investigate artificial colouring and flavours. Investigate upgrading of waste materials from yeast or whey industry. **Use of foods** Consider several common foods and compare their contents. Compare animal and plant food sources for content. Compare the main types of farming in different regions of the UK or the world. Investigate why some farmers raise livestock while others prefer to grow crops. **Conflicts and issues** Identify on a world map regions where food shortages and food surpluses exist and investigate the reasons for this. Consider the ethical issues involved in genetic modification

Fragile Earth – Water		
Key areas	**Suggested contexts**	**Suggested learning activities and exemplified key areas**
For **two** different water supplies, one local and one global, investigate and compare: ♦ source/origin, extraction ♦ use (as appropriate) ♦ conflicts, benefits and issues	There is a problem with your local water supply. The main water pipe that supplies the town has been damaged, or terrorists poison the water, accidental pollution. Choose the scenario which would best motivate. The water has been cut off.	Activities are themed around a context and are designed to allow pupils to answer the questions posed through practical experiments and web-based research. General websites which give an overview: The Creative Chemistry website and Science Buddies website (Earth and Environmental Science) give ideas for various practical projects. There are several websites: Scottish Water Education website, Wateraid Learnzone; Practical Action, water and sanitation; Engineering without Borders, Water Filter Challenge. Scottish Water, Education area of website. The SEPA website has useful background information for teachers. Additional internet resources are given for each relevant activity or content. **Introduction** Suggested content: Local reservoirs and location of water supplies and reservoirs. Information on this can be found on the Scottish Government website, environment and water area. How does water arrive in our homes? Drinking water comes through main water pipes from reservoirs. Visit a local reservoir and or water treatment works Investigate how much water there is on the surface of the Earth and what % of the human body/plants etc. is water. How Stuff Works website, under how much water is there on Earth is a useful resource for this.

	How does water get to the reservoir?	How does water get to the reservoirs? A water cycle PowerPoint and diagram can be found on the Jefferson Lab website. Another water cycle diagram can be found on the Enchanted Learning website. Another way of presenting the water cycle is the Water Cycle Wheel on the Illinois Environmental Protection Agency website, in the Kids and Education area of the site. Why does water need to be purified? What water-borne diseases can occur even in industrialised countries? The Water Aid website is a useful resource for this. What is in tap water, pond water? Look at tap water under microscope, evaporate it. Similarly, evaporate pond water. Investigate water-related diseases. Investigate why chlorine makes water safe to swim in and/or drink. Chlorination. This can be found on a commercial company's website, Prowater Ltd. Water can be used as a means of mass medication. Fluoridation. Information about this can be found on NHS South Central website. Investigate how commercially available water purification systems work, eg boiling, filtration, activated charcoal absorption, chemical disinfection, ultraviolet purification, solar water disinfection, solar distillation, homemade water filters. Information and projects on these suggestions can be found on the Water Filter Challenge website, a portable water purification system can be found on the Wikipedia website. Design your own method for collecting water from the atmosphere. Investigate how hot countries with little rainfall obtain freshwater. The Darjeeling Children's Trust website has information about water harvesting techniques. The Eco School website has a water butt to purchase.

		Information about a Water Purification Station is available on the web. Design a water filter to clean muddy water and discuss how safe the water would be for drinking. World water filter challenge can be found on the Engineers Without Borders website. Domestic usage of water: the US Environmental Protection Agency (Water Sense Kids).
	Why is water so important? What are the consequences for your community? Think of the different people in your family, street, the school, shops, offices, factories, leisure facilities. Choose one group you want to help. How would each of them be affected? What activities would be affected? List the problem each would have. What are some solutions?	Investigate how water is needed for cleaning, drinking, cooking, farming, industry and leisure activities: eg use manufacturer's data to find out how much water a washing machine or dishwasher uses. At home, the learners can investigate how much water is used when brushing teeth by putting the plug in the sink while brushing their teeth and then comparing the amount of water used if they turn the tap on only when needed. How much water was in the sink this time? Cleaning: information about using waste water and cooking in the Third World can be found on the Saakshar School Appeal website. Visit to a local swimming pool. This is an opportunity to cover chlorination so can be tied in with above or used separately. Information about water and agriculture can be found on the Water and Agriculture website. Hydroponics and irrigation systems, hydroponics. Scope Curriculum website has information on growing plants by hydroponics and a hydroponics diagram. Grow seeds with varying amounts of water. Investigate the efficiency of soft and hard water for cleaning eg lathering of detergent. There is an experiment about hard/soft water on the chemistry part of About.com website.

		Make a cup of tea with hard and soft water and compare what is left in the cup. Investigate an industry that uses a lot of water, eg dyeing, paper making. Information about dyeing can be found on Wikipedia and on the Creative Chemistry website. Make paper by recycling, instructions on the What Katie did website, 'I made paper with 5 year olds', Filth Wizardry website. Collect drinking water from salt water by evaporation. Discuss the practicalities of desalination to obtain fresh water, eg whisky, paper, soft drinks etc. The principals of desalination A simple diagram of desalination and information about desalination can be found on the Water Online website in the article 'Yale To Build Novel Forward Osmosis Desalination Pilot Plant'. The principles of distillation. Resources for this are readily available in Standard Grade resources. Global issues are dealt with on Water Aid, Learn Zone area of the website and water and sanitation area of the Practical Action website.

Human Health

What is health? – social/mental/physical

This Unit covers the individual's immediate health, expanding to taking responsibility for the family's health. It then looks at health within the community, and finally global issues affecting health. In this Unit there is opportunity for learner personalisation and choice. Teachers/lecturers may choose the appropriate health parameters for their learners and not all are expected to be covered.

Typical resources:
Resources such as BBC, NHS website, Discovery or Channel 4 will cover just about every health issue from preventative health to childhood infections, cancer to healthy weight levels.
Many free apps or useful interactive anatomy sites are available.
The World Health Organisation site has lots of information on diseases worldwide.
Many of the above sites will provide interactive games so that learners can choose games and quizzes related to organs.
Sites relating to quitting smoking will provide information on smoking and pollution and their effects on lungs.
Many sites provide information specific to disease, eg diabetes, heart disease.
Science videos: obesity, lungs and smoking, health and disease, nutrition, deficiency, substance misuse.

The meaning of health

Key areas	Suggested contexts	Suggested learning activities and exemplified key areas
Establishing what is meant by health. Social, physical and mental components.	Learners can complete a personalised health report. Content of report could include: ♦ describing in detail the main features of a healthy lifestyle ♦ recognising and discussing the various healthy parameters for a teenage body, and how this is related to circulation and breathing ♦ describing how various parameters relating to health are measured, including circulation and breathing ♦ discussing aspects of health relating to lifestyle	Suggested areas may include: ♦ Explore the health triangle. ♦ Normal pulse rates, how to measure and what can affect them. Extremes of pulse rate. ♦ Relationship between recovery time and health. ♦ Measurement of blood pressure, and causes and consequences of extremes. ♦ Describe advantages and disadvantages of high- and low-tech measuring devices. ♦ Body temperature, measurement and diagnosis of small changes, within key age groups. Learners could attend a first aid course/ invite medical practitioners for talk etc and undergo/carry out a health assessment of peers/staff/fictitious person at the beginning of the course.

		Outside speakers eg health visitors, school nurse, St. Johns ambulance, Police. Meditation and relaxation techniques. Survey and (if appropriate) measure health of staff and learners, eg: ♦ blood pressure ♦ pulse ♦ tidal volume ♦ vital capacity ♦ temperature ♦ body fat ♦ vaccination ♦ peak flow Equipment in for measuring height, weight (optional), skin fold callipers. Pulse can be measured using a pulsometer or heartrate monitor, stethoscope/finger and stopwatch. Blood pressure can be measured using a digital sphygmomanometer or a stethoscope and mercury manometer. Peak flow. Learners can watch videos, research or use information from informed speakers to identify causes and treatments for various health issues. Examine lungs from a sheep to compare clean lungs with photographs of smoke-damaged lungs.

Health issues		
Key areas	**Suggested context**	**Suggested learning activities and exemplified key areas**
Health issues	Possible use of scenario of two different family situations to analyse and discuss aspects of healthy living and supportive environments. Examples could include a two-plus-two working family with an elderly dependant, compared with a single, unemployed mother. Mixing-up of stereotypes, should then be encouraged, to include some of the following: ♦ poverty ♦ hygiene ♦ drug and alcohol abuse ♦ smoking ♦ sexual health ♦ diet and obesity ♦ exercise ♦ stress and mental health ♦ mobility impairment Learners may produce their own versions of specific scenarios predicting possible issues and necessary interventions	Suggested areas may include: ♦ Energy balance study. ♦ Knowledge of various vitamins and minerals and effects of deficiencies/ disorders. ♦ Examine labels on foods comparing nutritional values for learner food diary. ♦ Burning foodstuff and graph work on results. ♦ Agar plates showing microbiological growth pre-/post-hand washing. ♦ Hand-washing techniques and UV light. ♦ Research meditation and relaxation techniques. ♦ Doctors visit to the school. ♦ Supermarket visit. ♦ Links to Government campaign on 'five-a-day'. ♦ Outside speakers from police, youth support services. ♦ Research poor diets and produce presentation poster examples of poor diets. Could include famine, anorexia, bulimia, and kwashiorkor, obesity, rickets. ♦ PowerPoint presentation on personality whose diet is specialised for their job. For example: sports person, explorer, athlete. ♦ Collect and discuss newspaper/magazine cuttings relating to health and relate to the three aspects of health.

Health claims		
Key areas	**Suggested contexts**	**Suggested learning activities and exemplified key areas**
Media report analysis. Evaluate, data analysis, thinking skills. Understanding risk.	Learners can choose a topical media health report to investigate and evaluate.	Suggested areas may include: ♦ Survey of class and what vaccinations they have had. ♦ Jenner's experiment. ♦ Effects on the body of poor hygiene. ♦ Possible internet/research project on worldwide diseases and controversial vaccination programmes. ♦ Investigate information on conditions such as asthma, cancer, depression. ♦ Investigate information on the effect of foods, eg energy drinks, fizzy drinks, effects of caffeine.

Applications of Science

This Unit lets learners explore science's contribution to communication technologies, new materials and how science helps the understanding of risk and how it can be reduced in modern life.
Teachers/lecturers may cover all key areas of the Unit using one context, a mixture of key areas in one context or as separate topics.

Key areas	Suggested context	Suggested learning activities and exemplified key areas
Communication technologies Principles and applications of telecommunications: electromagnetic waves (radio, microwaves and light waves) and sound waves Applications — from at least two of: ♦ satellite technology ♦ fibre optics ♦ electromagnetic wave technology ♦ storage technologies ♦ opto-electronics ♦ screens ♦ speakers /ear phones etc. ♦ amplifiers ♦ microphones ♦ radio Others	The contexts given below can be used to cover all or some of the key areas in this Unit. **Adventure race** Adventure race involves a team of young people who have to kayak, cycle, run, abseil and canoe around a 10 mile course. Materials suitable for these activities are explored. In particular, telecommunication and satellite technology can be explored when one of the participants gets lost or hurt and rescue or medical assistance is required. However, they find it difficult to maintain a signal possibly due to the terrain or weather. One of the team remembers passing a forester's hut which contains a radio set. Could the radio be used to call for help? The way in which the news media report the incident and how this is communicated to an audience via television, radio and the internet could be explored. On being safely rescued one of team is taken to hospital where their leg is X-rayed. The X-ray is automatically digitised and displayed on one of the hospital monitors for analysis. Risk and safety issues can also be considered in relation to young people taking part in an adventure race.	Investigate the distance over which a mobile phone signal can be received using cell maps available from network operators Investigate the effect of wavelength on the ability of a wave to bend round obstacles. Research the different frequencies used to operate mobile phones, TV signals and radio signals. Investigate the frequency of a transmitted mobile phone signal. Use internet sites which track, in real time, orbiting satellites. The same sites could be used to compare the height and speeds of satellites. Geostationary satellites could be investigated. Bluetooth communication between phones could also be investigated. Investigate the focusing of waves by curved (concave) reflectors. Investigate the gain of an amplifier by comparing an amplifier input voltage with its output voltage. Investigate the focusing of waves using a ray box and concave lenses to illustrate focusing of signals using curved reflectors. Measure the thickness of optical fibres using a digital vernier gauge. Investigate the advantages of fibre optics over copper cables. Various videos online of how optical fibres are made. Build a simple circuit containing an LED. Use a signal generator to investigate the digital properties of an LED. This can demonstrated that an electrical signal can be converted to a light signal. Investigate total internal reflection of light rays using ray boxes and

	Car science On a car journey a breakdown/accident occurs. Investigate the science in cars eg, music systems, voice recognition, satellite navigation storage systems. Smart materials around bumpers and Telecommunication technology should be investigated. Transport risk and safety issues could be addressed. Hospital visit could lead to the science around fibre optics, X-rays and other materials used in health.	semi-circular transparent blocks. Investigate the medical applications of X-rays. Use a radio receiver (eg a mobile phone) to illustrate the conversion of radio signals to electrical signals and into sound waves. Videos/cds are available which cover the following: Electromagnetic radiation — where does this radiation come from and how do the frequencies and wavelengths vary? Microwaves are not only used to heat food but also to communicate over large distances. How has GPS enhanced our lives — from military systems to social applications like tagging locations in Facebook, or locating hillwalkers. The properties of high frequency electromagnetic radiation, allowing physicians to look inside the human body and even combat cancer. There are BBC class clips on mobile phone coverage/GPS opinions including parents tracking children. Other communication videos on include: How do mobile phones work? Submarine communication. Echolocation: dolphins, The satellite story, Satellites, How does GPS work? Option to expand communications topic to include materials: ♦ The science behind materials used for sports clothing, eg waterproofs, wicking material (material that dries quickly). ♦ The materials used in the making of sporting equipment, eg bikes, canoes and kayaks. ♦ Exploration of the aerodynamics with regards to cycling and water sports ♦ Look at design of footwear for different sports. ♦ These points may expand the breath of the context from a physics topic into a more general science subject.

Materials Source, production, use and issues. At least two from: ♦ plastics ♦ fibres ♦ 'smart' materials ♦ alloys ♦ cosmetics ♦ composite materials ♦ biological ♦ recycled	Either approach as stand-alone topic on materials or incorporate into contexts given above. **Smart materials — sensory room** You are an interior designer and you have been commissioned to create a multi-sensory room, eg for a child with autism/ASD or for a state-of-the-art bedroom. As well as smart materials and telecommunications, other areas which could be investigated are given in the column on the left.	Suggested activities for sensory room can be found on BBC Bitesize website, eg designing with electronics and materials. **Colours** Pupils could investigate colour changes using: Toy ducks with thermochromic pigments'Baby bath thermometers Thermochromic wire/film (secret message) Mugs with thermochromic UV beads/thread – investigate sun cream. Clothes that change colour. Suitable videos (Dragon's Den/The Apprentice) They could also predict future uses and possible environmental issues *Note — The 'colour change' ducks contain thermochromic pigments which change colour in response to heat and that these can be added to fabric.* *Show learners UV beads which change colour when exposed to UV radiation. Explain how photochromic pigments can be added to fabric and that they can change colour when exposed to UV radiation. Show pictures of smart bikini which can be used to measure UV exposure and help protect skin.* *A smart material changes its properties due to external stimulus.* *Give examples of smart materials which change colour due to outside stimuli.* *Know that a thermochromic materials change colour because of changes in heat.* *Be able to give use(s) of smart colour materials.* **Fluids** Be able to give example(s) of use(s) of smart fluids. Be able to come up with solutions to problems using smart fluids. Smart putty (hammer or throw at wall). D3O Video on YouTube (smacking spade on head with D3O hat). Custard bouncy balls (borax, custard powder and PVA glue).

		Without custard powder — noisy putty. Cornflour/water mix (quick sand). *This experiment shows that fluids have the ability to flow and are not necessarily liquids. They should know that materials exist which can behave as both liquids and solids.* Brainiac on YouTube — swimming pool filled with custard. Brainiac — quick sand. Ferrofluid and magnet (used in speakers) (suitable videos on internet). Polymorph (thermoplastic). Predict uses in future and possible environmental issues. Learners should understand the basic operating principle of a shape memory alloy/plastic (that it 'remembers' to return to a particular shape when heated). They should also know some applications of this property. Short length of memory wire (nickel-titanium), memory alloy springs. Possible kits — muscle wire kit (simulate muscle contraction). Memory foam (mattresses and pillows) (bed shops have free samples). Memory foam was developed by NASA for use in space. Car bumpers made from memory foam'can be reshaped after an accident. Quantum Tunnelling Composite — material that conducts electricity when pressure is applied (used in ski/sport jackets to function mobile phones and iPods from the sleeve) Video on gadget show website. Transparent conducting oxide glass: predict uses in future and possible environmental issues. Learners could investigate how this could be used in the future for displaying TV screens on fabric and walls. Memory flex glasses. *Note — This demonstration will introduce learners to glass used in the manufacture of solar cells. They have a conducting oxide layer*

	Cosmetic wonder product A wonder product has appeared on the market. Examples of the product could be: ♦ tanning product ♦ skin cream ♦ a semi-permanent tattoo ♦ acne treatment The drug, or cosmetic company, has scientific evidence to show how effective the product is. It becomes a market leader and the company makes a lot of money from it. The product is derived from a biological source. Claims on the dangers of this product start to appear. Risk issues can be explored as well as source, production, use and issues.	*on one side only. This can be simply demonstrated using a multimeter set to measure resistance and placing the leads on conducting and non-conducting surfaces and comparing the results. One side has a low resistance and conducts whereas the other side has a high resistance and does not conduct.* Learners could also investigate fibre optics if not done already in telecommunications — transmit light. **Science of skincare** (a) Tanning products Structure of the skin. Investigate the ingredients in the tanning and bronzers. Investigate how tan-enhancers work Explain why some tanning products smell. How do tanning products stain the skin? How do tanning pills work? Discuss the dangers of tanning pills. Tanning products vs. sun beds. Describe the effect of UV radiation on UV beads experiment and relate this to the increase in melanin in the skin What is melanin? What does it do? Examine guidelines around safe exposure to sunlight. How do you assess how a good tanning product is? Examination of skin melanomas caused by UV radiation. Ingredients of sun block cream. What are the active ingredients in sun cream? (b) Skin cream Structure of the skin. Make home-made creams (emulsions). Examine the ingredients of exfoliant products. Compare ingredients of cheap and expensive creams. Discuss the scientific claims made by cosmetic companies. (c) Body art Structure of skin. Use chromatography investigate contents of tattoo ink and non-permanent ink. How are tattoos applied?

		How are non-permanent tattoos applied and removed? Issues around body art (age of consent, risk of infection, permanency, peer grouping). Risks of home-tattooing. How are tattoos removed? Examination of infected tattoos and attempts to remove tattoos (d) Acne treatment Structure of skin. What is acne? Chemical treatment of acne. Radiation treatment of acne. Analysis of the scientific claims made by drug companies.
Risk and safety Identifying, measuring (risk assessment) and minimising risk for at least one of the following ♦ home safety (including safety devices) ♦ electrical safety — earth wire, fuses, circuit breakers, trip switches ♦ work safety ♦ transport safety (eg airbags, seat belts, response times) ♦ radiation safety	Either approach as stand-alone topic on risk and safety relating to real-life examples which are linked in to the areas covered in the Course or incorporated into contexts given. You could also approach Risk and Safety as a context or give a 'Bringing it all together' task at the end. For example, 'you are a group of car designers and have to give a health and safety report and risk assessment to your company director'. Home safety may be more appropriate for National 3. **Electrical safety** Earth wire, fuses, circuit breakers, residual current monitor (in lawnmowers and guitars). Make circuits to simulate alarms. Learners could explore electronic systems and their applications in real life situations.	**Electrical safety** How Stuff Works could also be used for electrical safety devices. video's on electrical safety. BBC Class Clips The dangers of approaching a powerful source of electricity are demonstrated on BBC learning zone clips. It includes images of dangerous sources of electricity which children might see in their local environment. To demonstrate the dangers of electricity, a dummy is moved towards an electricity cable and is struck by electrical sparks. The importance of following the instructions on the warning signs is explained. There is also an introduction to the

		concept of electric shock and the functions of fuses and RCDs. A fuse is designed to allow several amperes of current before it melts or blows. In this way it protects household wiring. A residual current device, or RCD, protects against electrocution by detecting any difference in current between connecting wires.
	Work safety Understand that everyone at work has a duty of care to follow the Safety at Work Act. Learners could look at various jobs and investigate the safety procedures, protective clothing. Link to the World Of Work and Work Experience using health and safety at work act. You could also investigate real 'case studies' online.	**Work safety** You can download leaflets/posters and videos eg what you need to know from the Health and Safety Executive government website. The government website also has 'case studies' of current British companies or you can search for an industry type. Pupils could choose area to investigate. There are numerous work experience resources which provide information for teachers, training providers, youth workers and employers. There are sites with activities for training, work experience preparation or classroom lessons. Eg wise up to work
	Chemical safety Could be included in home safety eg cleaning chemicals Identify chemical hazard symbols. Identify risks in chemical safety and how they are minimised. Learners do not need to do full COSHH assessments. They should understand the terms hazard, risk, hazcard, risk assessments and be able to identify hazard symbols. Pupils do not need to do full COSHH assessments. Pupils should understand the terms hazard, risk, hazcard, risk assessments and be able to identify hazard symbols.	**Chemical safety** Hazcard dominoes/safety symbol games on TES and numerous websites let you design your own hazcards. BBC Bitesize and EChalk have information and activities on hazard symbols. Learners could investigate dangers of chemicals that they will come across in school science labs and in the home, and write simple risk assessments for those chemicals.
	Transport safety Identify risks in transport safety and how they are minimised.	**Transport safety** Experiment — Crash trolleys with dummies. Use with/without elastic bands for seatbelts.

		Experiment — Egg and sheet experiment can be found on the Practical Physics website. Video on safety. Debate on speed limits. Video on BBC Class Clips – Cars that automatically obey the speed limits. Breaking distances under different road and tyre conditions. Investigate design features which reduce the impact of forces on drivers, eg airbags. Investigate other real-life examples, eg gannets — diving sea birds in Scotland with 'airbags' in their heads. There are video clips and information on these birds on the BBC website. Experiments for response times, drunk glasses using prisms. Drug and drink driving. Various websites have response time tests which you can try whilst using a mobile phone etc to see how response time is affected. Debate about using mobile phones whilst driving. Echalk website has useful animations. Requires subscription for full version but previews available for free — eg stopping distance, reaction test, safe driving. BBC class clips have video clips about safety and bike riding. Top Gear has clips of Stephen Fry when he decided to give up his motorbike.
	Radiation safety Learners could investigate identifying risks in radiation safety and how they are minimised.	**Radiation safety** X-rays in hospitals/dentists. Why use a lead vest? Why do dentists/doctors use radiation badges? Information about radiation from mobile phone masts/cell phone radiation can be found on various websites like How Stuff Works. Various videos including reducing radiation risk, MRI, radioactive half-life etc. BBC Class clips could also be used.

Developing skills for learning, skills for life and skills for work

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Course Specification* lists the skills for learning, skills for life and skills for work that learners should develop through this Course. These are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and must be built into the Course where there are appropriate opportunities. The level of these skills will be appropriate to the level of the Course.

For this Course, it is expected that the following skills for learning, skills for life and skills for work will be significantly developed:

Numeracy
This is the ability to use numbers in order to solve problems by counting, doing calculations, measuring, and understanding graphs and charts. This is also the ability to understand the results.

Learners will have opportunities to extract, process and interpret information presented in numerous formats including tabular and graphical. Practical work will provide opportunities to develop time and measurement skills.

2.1 Number processes
Number processes means solving problems arising in everyday life through carrying out calculations, when dealing with data and results from experiments/investigations and everyday class work, making informed decisions based on the results of these calculations and understanding these results

2.2 Money, time and measurement
This means using and understanding time and measurement to solve problems and handle data in a variety of science contexts, including practical and investigative

2.3 Information handling
Information handling means being able to interpret science data in tables, charts and other graphical displays to draw sensible conclusions throughout the Course. It involves interpreting the data and considering its reliability in making reasoned deductions and informed decisions. It also involves an awareness and understanding of the chance of events happening.

Thinking skills
This is the ability to develop the cognitive skills of remembering and identifying, understanding and applying. The Unit will allow learners to develop skills of applying, analysing and evaluating. Learners can analyse and evaluate practical work and data by reviewing the process, identifying issues and forming valid conclusions. They can demonstrate understanding and application of concepts and explain and interpret information and data.

5.3 Applying
Applying is the ability to use existing information to solve science problems in different contexts, and to plan, organise and complete a task such as an investigation.

5.4 Analysing and evaluating
This covers the ability to identify and weigh-up the features of a situation or issue in science and use judgement of them in coming to a conclusion. It includes reviewing and considering any potential solutions.

In addition, leaners will also have opportunities to develop literacy skills, working with others, creativity and citizenship.

Literacy
Learners develop the skills to effectively communicate key chemical concepts, make informed/reasoned decisions and describe/analyse/evaluate clearly chemical issues in written media. Learners will have the opportunities to communicate knowledge and understanding with an emphasis on applications and environmental/ social impacts. Learners will have opportunities to develop listening and reading skills when gathering and processing information.

Working with others
Learning activities provide many opportunities, in all areas of the Course, for learners to work with others. Practical activities and investigations, in particular, offer opportunities for group work, which is an important aspect of science and should be encouraged.

Creating
Through learning in Science, learners can demonstrate their creativity. In particular, when planning and designing experiments/investigations, learners have the opportunity to be innovative in their approach and do/make/say/write something new.

Citizenship
This course has many opportunities for an extensive range of practical activities which provides learners with the opportunity to work cooperatively with others. Learners will develop citizenship skills when considering the applications of science on society/the environment.

Approaches to assessment

Assessment should be integral to and improve learning and teaching. The approach should involve learners and provide supportive feedback. Self- and peer-assessment techniques should be used, where appropriate.

See the *Unit Support Notes* for guidance on approaches to assessment of the Units of the Course.

Added Value

Courses from National 4 to Advanced Higher include assessment of added value. At National 4 the added value will be assessed in the Added Value Unit

Information given in the *Course Specification* and *Added Value Unit* about the assessment of added value is mandatory.

The Science Added Value Unit is assessed by an Assignment. Prior to doing this Unit, learners would benefit from having covered key areas from at least one of:

- Science: Fragile Earth (National 4)
- Science: Human Health (National 4)
- Applications of Science (National 4)

It is intended that the majority of the time for the Added Value Unit should be spent in learning and teaching activities, which further develop the skills necessary to conduct investigative/practical work in Science. In addition to ensuring that learners are suitably prepared to conduct simple background research using the internet, learners should also have the opportunity to become familiar with practical techniques. Safety is integral to all practical work and learners should be encouraged to see risk assessment as a natural part of the planning process for all practical activity. Learners should have opportunities to assess risks and take decisions regarding the use of appropriate control measures during the planning stage of practical experiments/investigations.

If the Added Value Unit is delivered as part of a Course, centres can deliver this Unit at any point during the Course. The Assignment need not be seen as an end-of-Course activity. However, teachers/lecturers may wish to delay the Assignment until the latter stages of the Course, in consideration of the points above. The Assignment should be carried out under supervised, open-book conditions.

Learners will use the skills, knowledge and understanding necessary to undertake an investigation into a topical issue in science. The teacher/lecturer may provide guidance to learners on topics for study, taking into account the needs of their learners and the relevance to everyday issues. While the learner should choose the topic to be investigated, it would be reasonable for the choice the learner makes to be one where the teacher/lecturer has some expertise and has resources available to enable the learner to successfully meet the Assessment Standards.

The Assignment offers opportunities for learners to work in partnership and in teams, though it must be clear, at each stage, that the learner has produced evidence of their contribution to any group work carried out.

Combining assessment across Units

If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units. If this approach is used then it is necessary to be able to track evidence for individual Outcomes and Assessment Standards.

Transfer of evidence: Outcome 1 in a Unit may be used as evidence of the achievement of Outcome 1 in other Units of this Course.

Equality and inclusion

The following should be taken into consideration:

Situation	Reasonable Adjustment
Carrying out practical activities	Use could be made of practical helpers for learners with: ♦ physical disabilities, especially manual dexterity, when carrying out practical activities ♦ visual impairment who have difficulty distinguishing colour changes or other visual information
Reading, writing and presenting text, symbolic representation, tables, graphs and diagrams.	Use could be made of ICT, enlarged text, alternative paper and/or print colour and/or practical helpers for learners with visual impairment, specific learning difficulties and physical disabilities
Process information using calculations	Use could be made of practical helpers for learners with specific cognitive difficulties (eg dyscalculia)
Draw a valid conclusion, giving explanations and making generalisation/predictions.	Use could be made of practical helpers for learners with specific cognitive difficulties or autism

As far as possible, reasonable adjustments should be made for the Assignment, where necessary. This includes the use of 'practical helpers', readers, scribes, adapted equipment or assistive technologies.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Course Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Course.

It is important that centres understand SQA's assessment arrangements for disabled learners, and those with additional support needs, when making requests for adjustments to published assessment arrangements. Centres will find more guidance on this in the assessment arrangements section of SQA's website: www.sqa.org.uk/sqa//14977.html.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled candidates and/or those with additional support needs) — various publications are available on SQA's website at: www.sqa.org.uk/sqa//14977.html.
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Overview of Qualification Reports
- Principles and practice papers for curriculum areas
- *SCQF Handbook: User Guide* (published 2009) and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- *Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool*

Administrative information

Published: April 2012 (version 1.0)

Superclass: to be advised

History of changes to *Course Support Notes*

Course details	Version	Description of change	Authorised by	Date

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Unit Support Notes

Unit Support Notes — Science: Fragile Earth (National 4)

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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Science: Fragile Earth (National 4) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- *Added Value Unit Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation, and knowledge and understanding of our fragile Earth. Learners will apply these skills when considering the applications of science on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

In this Unit only two of the key areas should be covered. The key areas are:

- Water
- Food
- Energy
- Metals

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 3 Science Course

There may also be progression from National 3 Biology, National 3 Chemistry, National 3 Environmental Science and National 3 Physics Courses.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the Science National 4 *Course Support Notes*.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in science or related areas
- further study, employment and/or training

Approaches to learning and teaching

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

In this Unit, learners will focus on two of energy, food, metals, or water resources. They will investigate these through activities related to their source or origin, production and/or extraction, use, conflicts, benefits, and issues and possible solutions, including one local, national, or global issue. Learners will gain knowledge of how basic science is involved in the cause, effect and resolution of environmental issues.

The contexts or scenarios for each curriculum area are retained between National 3 and National 4 to allow flexibility in teaching and permit differentiation. Progression between the two levels may involve studying two different areas at National 4 from those previously studied at National 3. Alternatively, the same area could be covered, using the differentiated outcomes or tasks to develop breadth and increase challenge for the learner.

Safety is integral to all practical work and learners should be encouraged to see risk assessment as a natural part of the planning process for any practical activity. The Outcome 1 provides an opportunity for learners to identify risks and plan the safety steps required.

Developing skills for learning, skills for life and skills for work

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of Units when they form part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and where possible enable personalisation and choice for learners in assessment methods and processes.

Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence.

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the learner by bringing together different Outcomes and/or Assessment Standards. If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence. Strategies for gathering evidence and ensuring that the learners' work is their own, could include: ♦ personal interviews during which the teacher or lecturer can ask additional questions about completed work ♦ an oral presentations on their work ♦ written reports in supervised conditions ♦ checklists to record authenticity ♦ supplementary sources of evidence, such as witness testimony, film or audio clips Evidence can be gathered from classwork, experiment, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods which could include a test of knowledge, understanding and skills.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in this document is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approach to assessment will generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled candidates and/or those with additional support needs) — various publications on SQA's website: http://www.sqa.org.uk/sqa/14976.html
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Overview of Qualification Reports
- *Overview of Qualification Reports*
- *Principles and practice papers for curriculum areas*
- *Research Report 4 — Less is More: Good Practice in Reducing Assessment Time*
- *Coursework Authenticity — a Guide for Teachers and Lecturers*
- *SCQF Handbook: User Guide (published 2009)* and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- *Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool*
- SQA Guidelines on e-assessment for Schools
- SQA Guidelines on Online Assessment for Further Education
- SQA e-assessment web page: www.sqa.org.uk/sqa/5606.html

Administrative information

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History of changes to Unit Support Notes

Course details	Version	Description of change	Authorised by	Date

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Unit Support Notes

Unit Support Notes — Science: Human Health (National 4)

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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Science: Human Health (National 4) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- the *Added Value Unit Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation, and knowledge and understanding of human health. Learners will apply these skills when considering the applications of science on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of:

- What is health?
- Threats to health
- Health claims

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 3 Science Course

There may also be progression from National 3 Biology, National 3 Chemistry, National 3 Environmental Science and National 3 Physics Courses.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the National 4 Science *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in science or related areas
- further study, employment and/or training

Approaches to learning, teaching and assessment

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

This Unit covers the individual's immediate health expanding to taking responsibility for the family's health. They look at the health within the community and, finally, global issues affecting health. In this Unit there is opportunity for learner personalisation and choice. Teachers/lecturers may choose the appropriate health parameters for their learners and not all are expected to be covered.

The contexts or scenarios for each key area are retained between National 3 and National 4 to allow flexibility in teaching and permit differentiation. Progression between the two levels may involve studying two different health issues at National 4 from those previously studied at National 3.

Safety is integral to all practical work and learners should be encouraged to see risk assessment as a natural part of the planning process for any practical activity. The Outcome 1 provides an opportunity for learners to identify risks and plan the safety steps required.

Developing skills for learning, skills for life and skills for work

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of Units when they form part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and where possible enable personalisation and choice for learners in assessment methods and processes.
Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence.

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the learner by bringing together different Outcomes and/or Assessment Standards. If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence. Strategies for gathering evidence and ensuring that the learners' work is their own, could include: ♦ personal interviews during which the teacher or lecturer can ask additional questions about completed work ♦ an oral presentation on their work ♦ written reports in supervised conditions ♦ checklists to record the authenticity ♦ supplementary sources of evidence, such as witness testimony, film or audio clips Evidence can be gathered from classwork, experiment, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods which could include a test of knowledge, understanding and skills.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in this document is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approach to assessment will generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled candidates and/or those with additional support needs) — various publications on SQA's website: http://www.sqa.org.uk/sqa/14976.html
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Overview of Qualification Reports
- *Overview of Qualification Reports*
- *Principles and practice papers for curriculum areas*
- *Research Report 4 — Less is More: Good Practice in Reducing Assessment Time*
- *Coursework Authenticity — a Guide for Teachers and Lecturers*
- *SCQF Handbook: User Guide (published 2009)* and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
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History of changes to Unit Support Notes

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Unit Support Notes

Unit Support Notes — Applications of Science (National 4)

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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Applications of Science (National 4) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- the *Added Value Unit Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation, and knowledge and understanding of applications of science. Learners will apply these skills when considering the applications of science on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of:

- Telecommunications
- Materials
- Risks and health and safety

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 3 Science Course

There may also be progression from National 3 Biology, National 3 Chemistry, National 3 Environmental Science and National 3 Physics Courses.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the National 4 Science *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in science or related areas
- further study, employment and/or training

Approaches to learning, teaching and assessment

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

This Unit lets learners explore science's contribution to communication technologies, new materials and how science helps the understanding of risk and how it can be reduced in modern life.

Teachers/lecturers may cover all key areas of the Unit using one context, a mixture of key areas in one context, or as separate topics.

The contexts or scenarios for each key area are retained between National 3 and National 4 to allow flexibility in teaching and permit differentiation. Progression between the two levels may involve studying different applications/materials at National 4 from those previously studied at National 3.

Examples of possible contexts for developing the Unit are given in the *Course Support Notes*, eg adventure race and car science.

Safety is integral to all practical work and learners should be encouraged to see risk assessment as a natural part of the planning process for any practical activity. Outcome 1 provides an opportunity for learners to identify risks and plan the safety steps required.

Developing skills for learning, skills for life and skills for work

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of Units when they form part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and where possible enable personalisation and choice for learners in assessment methods and processes.

Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence.

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the learner by bringing together different Outcomes and/or Assessment Standards. If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence. Strategies for gathering evidence and ensuring that the learners' work is their own, could include: ♦ personal interviews during which the teacher or lecturer can ask additional questions about completed work ♦ an oral presentation on their work ♦ written reports in supervised conditions ♦ checklists to record authenticity ♦ supplementary sources of evidence, such as witness testimony, film or audio clips Evidence can be gathered from classwork, experiment, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods which could include a test of knowledge, understanding and skills.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in this document is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approach to assessment will generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

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