

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 *Unit Specifications*. **Suggested learning activities** are not mandatory. This offers examples of suggested activities from which you could select a range. It is not expected that all will be covered. The contexts for key areas are open to personalisation and choice, so centres are likely to devise their own learning activities. **Exemplification of key areas** is not mandatory. It provides an outline of the level of demand and detail of the key areas.

Risk assessment should always be carried out prior to doing any of the experiments and demonstrations listed.

Fragile Earth	
<p>In this Unit there are opportunities for personalisation and choice. Learners will focus on two from:</p> <ul style="list-style-type: none"> ♦ energy ♦ metals ♦ water ♦ food <p>They will investigate these resources through activities related to their source, origin, production and/or extraction. Uses and benefits will be explored. Conflicts and possible local or national solutions will be identified. Learners will gain knowledge of how science is involved in environmental issues.</p>	
Fragile Earth — energy	
<p>For one renewable and one non-renewable source, investigate and compare:</p> <ul style="list-style-type: none"> ♦ source/origin ♦ production ♦ use (as appropriate) ♦ conflicts and benefits <p>Possible solutions: local or national</p>	
Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Scenario You live in a small town on the coast. The nearest big city is about 75 miles away. Most people in your</p>	<p>Learners could investigate types of energy (potential, kinetic, chemical, etc) and the differences between them. Experiments using different machines, toys, etc, can be used</p>

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 to be 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 provide a backup when the generator breaks down.

The town council have decided to provide a central source of energy to bring 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 is energy anyway?

What can we do to save more energy?

We still need a reliable energy source! How can we generate energy cheaply?

Will the cheapest method be safe or environmentally friendly?

to draw energy transfer equations.

Conduction, convection and radiation

Principles and mechanisms for heat transfer are available on the internet with animations and videos to support teaching.

Practical activities could include investigating different materials for insulation and/or conduction. For instance:

Thermal conduction through glass, steel and copper from a Bunsen burner, measured by the time it takes for a paperclip to fall when attached to each medium with Vaseline.

Temperature drop from a polystyrene cup wrapped in different materials.

Ways to insulate your home: the Energy Saving Trust is a good source of information for learners. A poster or diagram could be prepared. Learners might choose one area or room in the house to focus on and adapt to conserve heat, or build a model of a house with different insulating materials.

Visit a building site for a view of how houses are designed to be energy efficient.

Parsel University also has an activity that allows learners to investigate how to heat and insulate a house ('How to Heat My House?') — different activities can be selected to differentiate where necessary.

Investigate the production of electricity from one renewable and one non-renewable source, eg wind power and natural gas. See the Energy Quest website for information on each of these sources.

Suggested practical activities

Use wind and water turbines or solar panels (equipment details available from SSERC) to generate power and compare different voltages achievable from the different methods. Try to power different devices using these methods and compare with the reliability of a rechargeable battery.

	<p>Make a battery from a lemon, potato or conventional salt solution using different metal electrodes. Evaluate the practicality of powering a device in this way.</p> <p>Try to heat water using a homemade 'solar cooker' (see Wikipedia) and compare with the use of a Bunsen burner.</p> <p>This could be approached as a PowerPoint (eg a slide for each question) or a group/pair presentation. What is the source of your energy? How is it made into electricity for your home? Which energy sources are the cheapest and why? Is cheapest always best? Why or why not?</p> <p>Demonstrate the production of acidic gases from fossil fuels by burning sulphur in oxygen and using a universal indicator solution to test the gas produced. Sparking air can also be used to show how acidic nitrogen oxides are produced by the spark plug in a conventional internal combustion engine.</p> <p>Chemical weathering of limestone is a good illustrative experiment for emphasising the effects of acid rain. The RSC website — learn chemistry includes a lesson plan for this activity. For a larger class or more extensive activity, the effect of acid rain on a variety of building materials is investigated in an AiFL three-week activity (details also available on the RSC website — learn chemistry).</p> <p>Thinking about power stations and internal combustion engines, learners might consider less harmful ways of producing the energy needed for homes and cars. A list of pros and cons could be compiled and the class could stage a debate and vote on their choice in a mock council meeting.</p>
Fragile Earth — metals	
<p>For two different metals, investigate and compare:</p> <ul style="list-style-type: none"> ◆ source/origin ◆ production and/or extraction ◆ use (as appropriate) ◆ conflicts and benefits <p>Possible solutions: local or national</p>	

Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Mobile metals of the future Who has got the metal you need?</p> <p>The centre chooses an application that they can research (the mobile phone, computer, solar cell, electric car etc).</p>	<p>Background knowledge As a preamble to the context, look at the properties and uses of metals. You may revise some of the practical activities at level 3 (3.15a, 3.17b and 3.19b).</p> <p>Investigate: conductivity (thermal and electrical), density, strength, malleability and ductility of at least two metals. Also, remember that metals are sonorous. Compare their properties with non-metals.</p>
<p>Scenario It is the 22nd century. We are running out of metals for communications and renewable energies. In an independent or post-recession Scotland (or a 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. These elements are integral to modern life, and are used in everything from disc drives, hybrid cars and sunglasses to lasers and military aircraft.</p>	<p>Use an interactive world map to investigate metal abundance, availability and cost.</p> <p>Some internet resources:</p> <ul style="list-style-type: none"> ◆ Videos on RSC website — learn chemistry will provide an illustrative background to metal properties and uses. ◆ From the TES website you can download various teacher and pupil resources that will teach the properties and uses of metals. ◆ RSC website — learn chemistry will give metal uses in pigments and in colour. This is a practical application of why metals are useful and can be used in the introduction to this topic. <p>You can use the RSC website — learn chemistry to show the 'flame colours — a demonstration'. This is an experiment with flame tests and explains why we see colours in metal pigments and fire works</p>
<p>Can you make a mobile phone, computer hard drive and solar panels out of the metals that can be dug up from your garden?</p>	
<p>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 or computer are ethically sourced?</p>	<p>Ethical resources Take a mobile phone to pieces and see which metals are used to make it. Similarly, find out about metals used for iPads and laptops.</p> <p>Lesson plans and class activities about recycling mobile phones, suitable for ages 12–16, can be accessed on the Oxfam website. These tie in with the topic of recycling valuable resources and using them to help others.</p>

<p>Precious metals</p> <p>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.</p>	<p>Precious metals</p> <p>To give some background to this context, there are some news articles on the Guardian website about thieves stealing metals.</p> <p>Investigate why these metals are being stolen by considering the following questions:</p> <ul style="list-style-type: none"> ◆ What are they used for? ◆ Why are they so valuable? (The recession is making metal costs rapidly increase.) ◆ How reactive are they? ◆ Can these metals be recycled? ◆ How abundant are they?
<p>New metals of the future</p> <p>New alloys can be made with different properties. For new technologies we need new materials. Which metals would we use to make a flying car or a space elevator?</p>	<p>New metals of the future</p> <p>An article in the New Scientist about making new alloys that are strong enough to make improved jet engines gives some background to this context. Investigate the uses of alloys and the new properties they give metals. Design a new alloy as a class activity. The RSC website — learn chemistry describes the following experiment: 'Making an alloy (solder).'</p>
<p>Metal catalysts</p> <p>These are used in many different ways to make new materials or to save energy. Investigate some of these, where they are found and how they are used.</p>	<p>Metal catalysts</p> <p>You can use the RSC website — learn chemistry to show 'The involvement of catalysts in reactions' — a demonstration of the oxidation of potassium sodium tartrate by hydrogen peroxide using a cobalt salt as a catalyst. This is an exciting and spectacular demonstration.</p>
	<p>'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. It gives some insight into why these metals are precious, and can be downloaded from the TES website.</p>
<p>Gold on our doorstep</p> <p>Gold is to be mined at Cononish near Tyndrum. Work on constructing the mine first began in the 1980s but low gold prices forced closure before the mine became fully operational. The mine is now</p>	<p>Gold on our doorstep</p> <p>News articles about the discovery of gold in Cononish near Tyndrum can be found on the Glasgow Herald and BBC websites, to give some background to this context.</p> <p>Some suggested activities that fit in with the topic include:</p>

<p>viable because the price of gold has gone up. Research 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?</p>	<ul style="list-style-type: none"> ♦ visiting a mine or mining museum (if available locally) ♦ gold panning, as a practical activity (this could be demonstrated with copper powder and sand in a sink!) <p>designing and making a medal for the Commonwealth Games (choosing between a pure metal and an alloy, by researching cost, availability and abundance)</p>
Fragile Earth — water	
<p>For two different water supplies — one local and one global — investigate and compare:</p> <ul style="list-style-type: none"> ♦ source/origin ♦ extraction ♦ use (as appropriate) ♦ conflicts and benefits <p>Possible solutions: local or national</p>	
Suggested contexts	Suggested learning activities and exemplification of key areas
<p>There is a problem with your local water supply. Either the main water pipe that supplies the town has been damaged, terrorists have poisoned the water supply, or accidental pollution has occurred. The water has been cut off.</p> <p>Due to an extreme weather event, your small isolated rural/large urban community has run out of water. Where will you find a new resource? For example, buy it in from another community, distil sea water, find a new source locally?</p> <p>Or:</p> <p>Due to an extreme weather event a small isolated rural/large urban community overseas has run out</p>	<p>Background knowledge</p> <p>As a preamble, look at the inherent properties of water:</p> <ul style="list-style-type: none"> ♦ melting point and boiling point (SCN 3–05a) ♦ solvent properties (SCN 3.16b) ♦ chemical test for water (there is an experiment on the RSC website — learn chemistry that shows the colour change that occurs in copper sulphate due to the presence of water) ♦ Look at tap water under a microscope and compare it to untreated pond water. ♦ Investigate water related diseases. ♦ Investigate why chlorine makes water safe to swim in and/or drink (there is an experiment on the practical chemistry website that looks at the dissolved solids in tap water and sea water. <ul style="list-style-type: none"> ♦ There are experiments on the RSC website — learn chemistry that show the processes of desalination of water and the separation of water from a mixture by distillation.

<p>of water. They want to buy an adequate supply of water from your abundant local resource. Can you provide enough good quality water for them?</p>	<ul style="list-style-type: none"> ◆ Design your own method for collecting water from the atmosphere. ◆ Use a rain gauge to measure rainfall and test this for mineral content and bacteria. ◆ Design and make water filters to clean muddy water, and discuss how safe the water would be for drinking. ◆ Investigate how commercially available water purification systems work. <p>Other suggested activities:</p> <ul style="list-style-type: none"> ◆ Visit a local water treatment plant, a swimming pool or another local facility that uses water. ◆ Use the Scottish Water (www.scottishwater.co.uk) and SEPA (www.sepa.org.uk) websites to find more information on water use, purification and pollution. <p>Practical activities that illustrate uses of water:</p> <ul style="list-style-type: none"> ◆ growing plants ◆ making paper ◆ investigating the effect hard and soft water on health and the effectiveness of laundry detergent. <p>Useful websites: www.creative-chemistry.org www.sciencebuddies.org www.wateraid.org/uk/learn_zone www.practicalaction.org/water-and-sanitation-14 www.ewb-uk.org [Engineering Without Borders] www.groundwater.org [Water Filter Challenge]</p>
<p>Fragile Earth – food</p> <p>For more than one source, investigate and compare:</p> <ul style="list-style-type: none"> ◆ source/origin ◆ production ◆ use (as appropriate) ◆ conflicts and benefits 	

Possible solutions: local or national

Suggested contexts	Suggested learning activities and exemplification of key areas
<p>The world Up to a billion people every day have nothing to eat, and half of children who die under the age of five do so because they are malnourished or starving.</p> <p>The world's population is more than 7 billion — and rising — but food shortages will continue and perhaps worsen due to climate change, damage to ecologies, using land for biofuels and other energy sources instead of for farming, increased energy costs and building cities.</p> <p>Our country Food is plentiful and this has led to different health problems such as obesity, diabetes and heart disease. In future, spiralling 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 have a significant impact on food production that will see a focus on farmed local produce and a reduction in livestock with necessary changes in diet.</p>	<p>Source, production and extraction</p> <p>Germination of seeds</p> <ul style="list-style-type: none">◆ Measure water content of stored and fresh seeds (eg peas) using dry weight and fresh weight.◆ Test seeds for starch, sugar and protein.◆ Grow a collection of plants from a variety of seeds (eg water cress, tomatoes, courgettes etc.) and investigate other sources of food, eg leaves, roots, flowers etc.◆ Demonstrate the conditions needed for the germination of seeds. <p>Plant growth and photosynthesis Test plants grown under different conditions to demonstrate the factors needed for photosynthesis. (There are internet resources to support this.)</p> <ul style="list-style-type: none">◆ Measure changes in mass of germinating seeds and photosynthesizing seedlings. Plot the changes over time on a graph.◆ Investigate the effect of the incorrect watering of plants.◆ Design and make a watering system for houseplants that 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 effect of sunlight, shade and artificial lighting on plant growth. <p>Fertilisers</p> <ul style="list-style-type: none">◆ Grow plants with natural and artificial fertilisers and compare with growth when no fertiliser is used.◆ Investigate which elements are needed in fertilisers (NPK) and examine the effect of adding each element.◆ Encourage pupils to evaluate whether artificial fertilisers are necessary or dispensable.

	<ul style="list-style-type: none"> ◆ Discuss the importance of nitrogen-fixing plants. ◆ Discuss alternative propagation techniques — pricking out seedlings sown earlier; potting on plants. ◆ Explore the effect of deadheading crop plants to improve yield. ◆ Compare different methods of controlling pests and diseases. ◆ Give examples of the ways in which genetically engineered plants are of economic importance — how they can be used to improve disease resistance, crop yield and taste/appearance. <p>Livestock production</p> <ul style="list-style-type: none"> ◆ Analyse and interpret data on the characteristics of selected species. ◆ Give two examples of improved characteristics resulting from selective breeding. ◆ Discuss economic importance of selective breeding. ◆ Genetic engineering of animals — the ethics of cases such as Dolly the sheep could be debated. <p>Biotechnology</p> <ul style="list-style-type: none"> ◆ Investigate various processing treatments for milk. ◆ Make yoghurt. ◆ Investigate different types of rennet. ◆ Make dough. ◆ Investigate the conditions necessary for fermentation to take place. ◆ Investigate artificial colouring and flavours. ◆ Investigate upgrading of waste materials from yeast or whey industry. <p>Use of foods</p> <ul style="list-style-type: none"> ◆ Consider several common foods and compare their contents (Internet resources are available: Chemical Industries; Food Basics). ◆ Revise the main food groups, examining food labels to find the different proportions of fat, protein and carbohydrate. ◆ 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.
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	<p>Conflicts and issues</p> <ul style="list-style-type: none"> ◆ Identify on a world map regions where food shortages and food surpluses exist. Investigate the reasons for this. ◆ Pupils could conduct ICT based research and present or debate on some or all of the following issues: <ul style="list-style-type: none"> the impact of fertilizers on the environment the impact of pollution on food production genetic modification of plants and animals selective breeding air miles versus local produce change of diet in developing countries and the global effects
	<p>From the TES website, use the following two activities:</p> <ul style="list-style-type: none"> ◆ A PowerPoint presentation that asks a pupil to link the special properties of titanium to its specific uses (golf clubs, aircraft, piercing and hip replacements). The presentation includes links to websites with video clips showing titanium's uses and a titanium quiz. It also looks at the extraction of titanium from its ore, via 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 they need, with links to a couple of short films for them to watch along the way. <p>Also consider other ways of extracting metals from their ores:</p> <ul style="list-style-type: none"> ◆ extracting copper from copper chloride using electrolysis ◆ extracting iron from iron (III) oxide using a match head ◆ extracting 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 ◆ extracting copper from copper oxide using a Bunsen burner and a piece of wood (as well as two safety mats — and be sure to cool the reduced copper oxide with water) <ul style="list-style-type: none"> ◆ 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.

	<ul style="list-style-type: none"> ◆ Do a school or class project on recycling metals. ◆ Make a new and useful item out of cans, bottle tops, foil wrappings etc. ◆ Build a sculpture using soldering.
Human Health	
<p>This Unit covers personal health, expanding to taking responsibility for the collective health of the family and the community. It also looks at global issues affecting health. In this Unit there are opportunities for learner personalisation and choice. Teachers/lecturers may choose the appropriate health parameters for their learners — it is not expected that all are covered.</p> <p>The World Health Organisation site (www.who.int) has lots of information on diseases worldwide.</p>	
Human Health — what is health?	
<ul style="list-style-type: none"> ◆ Establishing what is meant by health ◆ Social, physical and mental components 	
Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Learners can recognise and record the various healthy parameters for a teenage body, and how these relate to age and fitness levels.</p> <p>Measurements could include:</p> <ul style="list-style-type: none"> ◆ poor health related to lack of exercise and diet ◆ relevance of high or low; heart rate, blood pressure and temperature 	<p>Suggested areas may include:</p> <ul style="list-style-type: none"> ◆ draw the health triangle ◆ normal pulse rates, how to measure and what can affect them ◆ extremes of pulse rate ◆ understand how recovery time is affected by health ◆ measurement of blood pressure — causes and consequences of extremes ◆ identify high and low tech measuring techniques ◆ body temperature — measurement and significance of small changes — within key age groups. <p>Students could attend a first aid course/invite medical/health professionals to give a talk/presentation; they could carry out a health assessment of themselves/peers/staff/fictitious people at the beginning of the Course, eg:</p> <ul style="list-style-type: none"> ◆ blood pressure (using a digital sphygmomanometer/stethoscope and mercury manometer) ◆ pulse (using a pulsometer/heart rate monitor/stethoscope and finger) ◆ temperature ◆ body fat (using skinfold callipers) ◆ vaccinations

	<ul style="list-style-type: none"> ♦ peak flow ♦ height ♦ weight (optional) <p>Learners can watch videos, research or use info from informed speakers to identify causes and treatments for various health issues.</p> <p>Examine lungs from a sheep to compare clean lungs with photographs of smoke damaged lungs.</p>
Human Health — threats to health	
Recognise contributory factors and preventative measures relating to social, physical and mental health.	
Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Different family scenarios to analyse and discuss aspects of healthy living and supportive environments. Examples could include a nuclear working family with an elderly dependant compared with a single, unemployed mother of one. Mixing up of stereotypes should then be encouraged, to include some of the following:</p> <ul style="list-style-type: none"> ♦ poverty ♦ hygiene ♦ drug and alcohol abuse ♦ smoking ♦ sexual health ♦ diet and obesity ♦ exercise ♦ stress and mental health ♦ mobility impairment <p>Learners could then produce their own versions of specific scenarios, identifying individual circumstances, possibly self-perpetuating. These could be categorised as social, mental health or physical health issues. The presented information</p>	<p>These may include:</p> <ul style="list-style-type: none"> ♦ energy balance study ♦ knowledge of various vitamins and minerals and effects of deficiencies/disorders ♦ examining labels on foods comparing nutritional values/food diaries ♦ burning foodstuffs to release energy and plotting results on a graph ♦ agar plates showing microbiological growth pre/post hand-washing ♦ hand-washing techniques and UV light ♦ researching meditation and relaxation techniques ♦ doctor/health practitioner visit to the school ♦ supermarket visit ♦ the <i>5 a day</i> campaign. ♦ outside speakers from the police/youth support services ♦ researching poor diets and producing posters highlighting possible outcomes (eg famine, kwashiorkor, obesity, rickets) ♦ PowerPoint presentation about a personality whose diet is specialised on account of their job (eg sports person, explorer) <p>Collect and discuss newspaper/magazine cuttings relating to health and relate to the three aspects of health.</p>

<p>could then be expanded, developing the scenarios and predicting possible issues and necessary interventions.</p> <p>Discussions or presentations on:</p> <ul style="list-style-type: none"> ♦ social aspects of unemployment ♦ aspects of dependency care ♦ physical and mental considerations ♦ home demands 	
Human Health — health claims	
<ul style="list-style-type: none"> ♦ media report/investigation ♦ understanding risk 	
Suggested contexts	Suggested learning activities and exemplification of key areas
Learners could choose a topical media health issue to investigate and on which to prepare a report.	<p>Suggested areas may include:</p> <ul style="list-style-type: none"> ♦ survey of vaccinations among classmates ♦ effects on the body of poor hygiene ♦ research project on worldwide diseases and vaccination programmes
Applications of Science	
<p>This Unit lets learners explore sciences contribution to communication technologies, new materials and how science helps the understanding of risk and how it can be reduced in modern life.</p> <p>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.</p>	
Applications of Science — telecommunications	
<p>Principles and applications of telecommunications: electromagnetic waves (radio, micro and light waves) and sound waves</p> <p>Applications — at least two from:</p> <ul style="list-style-type: none"> ♦ satellite technology ♦ fibre optics ♦ electromagnetic wave technology ♦ storage technologies 	

- ♦ opto-electronics
- ♦ screens
- ♦ speakers /ear phones etc
- ♦ amplifiers
- ♦ microphones
- ♦ radio
- ♦ other

Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Adventure race Adventure race involves a team of pupils that 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. 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 pupils 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.</p> <p>Car science On a car journey a breakdown/accident occurs. Investigate the science in cars, eg music systems, voice recognition, satellite navigation storage systems. A hospital visit could lead to the science around x-rays.</p>	<p>Investigate the possible 'journey' of a mobile phone message. Suggest a possible reason as to why a mobile phone signal might not be received ie to great distance from a receiving station, a weak signal or a physical barrier such as a hill. Investigate the use of microphones, eg by speaking through a microphone connected to a CRO. Investigate the use of loudspeakers, eg by connecting a speaker to a signal generator. Take part in a demonstration on how an amplifier can be used to 'boost' an electrical signal. Carry out investigations into the reflection of light off a plane mirror and at the boundary between a glass block and air.</p> <p>Investigate the use of curve reflectors to focus rays of light. Build a simple circuit containing an LED (connecting an LED to a signal generator could be used to vary the flashing rate of the LED). Carry out an investigation into how a light signal can be transmitted in an optical fibre. How has GPS satellites enhanced our lives, from military systems to social applications? There are BBC class clips on mobile phone coverage GPS opinions including parents tracking children. Other Communication videos on the internet include: How do mobile phones work?, Submarine communication, Echolocation: dolphins, The satellite story, Satellites, How does GPS work?</p>

<p>Either approach as stand-alone unit on risk and safety relating to real life examples which are linked in to the areas covered in the Course or incorporate into all other sections/contexts. You could also approach Risk and Safety as a context or give a 'Bringing it all together' task at the end. For example:</p> <p>Imagine that you have been employed by the fire department to visit homes and schools to identify and minimise safety risks.</p>	
Applications of Science — materials	
<p>Source, production, use and issues At least one from:</p> <ul style="list-style-type: none"> ◆ plastics ◆ fibres ◆ 'smart' materials ◆ alloys ◆ cosmetics ◆ composite materials ◆ biological materials ◆ recycled materials 	
Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Material design challenge Dragon's Den type activity. You have to pick novel material/product. This product must have a practical use. Investigate the use of plastic, fibres, biological, recyclable and smart materials.</p>	<p>Learners could investigate fibres/plastics/composite materials/biological materials.</p>

Sport	Fashion	Child safety	Fabric TVs	
A skiing jacket with QTC. This substance conducts electricity and can be woven into clothes. Can be used with MP3 players etc.	A hat made from a material that is soft that copes with sudden impact.(D30)	A baby grow that changes colour when the baby is too cold or too hot.	A material that can have TV programmes projected on it.	Teflon coated material.

Investigate the properties of plastics and problems with them.

New specialised polymers: Examples — Biopol, Poly(ethanol) (disposable laundry/environmental bags can be purchased to demonstrate solubility), Polyvinylcarbazole, (SSERC experiment to make plastic that conducts), Kevlar Shape Memory Plastic Polymorph (thermosetting plastic) — can be purchased

Colour changing clothes — Thermochromic thread

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.

Alloys/Shape Memory Alloys (medical stents, fire alarm sprinklers, GPS/Mobile phone satellites)

Carbon fibres — Possible new uses (tennis racquets, skis)
Fullerenes and nanotubes(1996 Nobel Prize)/Graphene (2010 Nobel Prize)

<p>Cosmetic wonder products: the Science of personal hygiene</p> <p>A wonder product has appeared on the market. Examples of this product could be</p> <ul style="list-style-type: none"> ◆ soap ◆ perfume ◆ hair products 	<p>Pupils can research the use of the material. How it can be applied and make a pitch to a panel of real-life Dragons. Literacy issues can be developed.</p> <p>Look at materials and videos on the internet concerning: RSC website — learn Chemistry and others:</p> <ul style="list-style-type: none"> ◆ alloys ◆ plastics and polymers ◆ the invention of nylon <p>Cosmetic wonder products: the Science of personal hygiene</p> <p>Soap</p> <p>Demonstrate that detergent can allow oil and water to mix. Make home-soap, shampoo and detergent. Investigate lathering. What is the difference between shower gel and soap? What are the differences between soap, detergents and shampoo?</p> <p>Perfumes</p> <p>Investigate the science of aromatherapy Issues around aromatherapy; are the claims made real? What are the ingredients of a perfume? Make a home-made perfume. Select information on types of perfume (eg Eau de Parfum, Eau de Cologne, Eau du Toilette etc).</p> <p>Hair products</p> <p>What is the structure of human hair? What is the difference of hair from different ethnic groups? What is the difference between different hair types; curly, thick, fine hair? What causes greasy hair? Perform a survey of pupils' use of hair products. Investigate how hair products work, eg hair gel, volumisers.</p>
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	<p>Investigate problems with hair, eg alopecia, lupus, ringworm, dandruff, premature balding, premature greying.</p> <p>What are the effects of chemotherapy and radiation therapy on hair?</p> <p>Test home-made shampoo against a commercial shampoo (SERC).</p> <p>What differences are there between conditioner and shampoo ingredients?</p> <p>Use wool/hair extensions as model hair to investigate the effect of different conditioners and shampoo.</p> <p>What are the ingredients of hair-colouring products?</p> <p>What are the differences between temporary and permanent hair colouring?</p>
Applications of Science – risk and safety	
<p>Identifying, measuring (risk assessment) and minimising risk for at least one of the following:</p> <ul style="list-style-type: none"> ◆ 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 	
Suggested contexts	Suggested learning activities and exemplification of key areas
<p>Home safety</p> <p>Identify risks in the home and investigate safety equipment used to minimize risks.</p> <p>Look at safety devices used to alert and protect people from risks.</p> <p>Learners could investigate how safety devices work, eg carbon monoxide detectors, heat detectors, smoke detectors, fire extinguishers, alarms for open doors/windows/swimming pools, baby monitors, tamper proof lids, plug guards, safety devices on gas cookers and interconnected smoke alarms.</p>	<p>Home safety</p> <p>Many resources online can be used to find out how these safety devices work. Other online resources include:</p> <ul style="list-style-type: none"> ◆ internet videos on carbon monoxide poisoning ◆ various websites promoting safety in the home, including fire safety, aimed specifically at pupils with videos, games and activities <p>The idea to develop an interactive safety game for children came out of Crucial Crew — a series of workshops held all over the UK for schoolchildren aged 8–11. It may well have a different name in your area, such as Junior Citizen or Citizenship Courses. At these workshops the children are presented with various dangerous or challenging situations, such as a road accident or a gas leak, and they engage in role-play exercises in how to deal with these situations.</p>

They could also investigate chemicals in the home and in the school laboratory, eg acids, alkalis, chemical cleaners and poisons.

Identify chemical hazard symbols.

Identify risks in chemical safety and how they are minimised.

Hazard dominoes/safety symbol games on TES and numerous websites let you design your own hazard cards.

BBC Bitesize and EChalk have information and activities on hazard symbols.

Pupils could investigate the dangers of the chemicals that they will come across in school science labs and in the home.