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 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 also not mandatory. It provides an outline of the level of demand and detail of the key areas.

Electricity and Energy		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
Generation of electricity Knowledge of advantages and disadvantages of different methods of electricity generation. Knowledge of the potential role of different methods of electricity generation in future sustainable energy supply. Awareness of the concept of energy efficiency and energy efficiency issues related to generation distribution and use of electricity. Knowledge of energy transformations and basic components of power stations.	Research energy supply and demand projections from current data. Research different energy sources. Prepare a plan for a Scottish island to be self-sufficient in electricity from natural resources. Research generation and transmission losses. Discuss the implications of distribution methods — overhead cables versus underground cables. Carry out investigations into generation of electricity, for example, dynamo, and methods of passing a magnet through coil of wire. Compare input and output energy for power stations using different energy sources. Research or investigate the factors affecting the electrical output from a range of sources, for example solar cells or wind turbines.	

	Research microgeneration such as home-based solar panels, wind turbines or hydro electricity. Observe a demonstration of model power lines.	
Electrical power Definition of electrical power as a measure of the energy transferred electrically to an appliance every second. Comparison of power consumption of heat producing and non heat producing appliances, qualitative and quantitative. Use of an appropriate relationship to solve problems involving power, energy and time. Awareness of energy efficiency as a key factor in conserving resources and the environment. Use of an appropriate relationship to solve problems involving efficiency given input and output power/energy.	Compare the efficiency of a microwave oven to that of a kettle by heating water. Input energy from smart meter or rated power/time and output from heat energy in water using specific heat capacity. Determine the efficiency of an electric motor or water pump. Compare the brightness of different types of lamp using a light meter. Carry out investigations with power/energy meters. Compare the information from various power rating plates.	$P = E/t$ $\%\ \text{efficiency} = \frac{\text{useful } E_o}{E_i} \times 100\%$ $\%\ \text{efficiency} = \frac{\text{useful } P_o}{P_i} \times 100\%$
Electromagnetism Sketch of magnetic field patterns between magnetic poles. Knowledge of the magnetic effects of electricity. Knowledge of some practical applications of magnets and electromagnets. Use of transformers in high voltage transmission.	Draw magnetic field patterns around permanent magnets using iron filings, etc. Investigate the magnetic field patterns around different shapes of electromagnets, for example a linear solenoid or a horseshoe shape. Examine a range of applications using permanent and electromagnets and justify why each type of	

	magnet is used. Research the range of applications of electromagnets — relays, bells, loudspeakers, fire door retainers, fail-safe brakes on lifts, Maglev trains, etc.	$\frac{n_s}{n_p} = \frac{V_s}{V_p}$
Practical electrical and electronic circuits Use of an appropriate relationship to solve problems involving voltage, current and resistance Measurement of current and voltage using appropriate meters in series or parallel circuits. Knowledge of the circuit symbol, function and application of standard electrical and electronic components including cell, battery, lamp, switch, resistor, variable resistor, voltmeter, ammeter, LED, motor, microphone, loudspeaker, solar cell, fuse, relay, LDR. Identification of analogue and digital input and output devices. Use of an appropriate relationship to solve problems involving the total resistance of resistors in series circuits. Use of AND/OR/NOT logic gates in electronic circuits.	Examine circuit diagrams of hairdryer wiring or car heater wiring for different heat settings. Examine circuit diagrams for vehicle electrical systems such as wiring of ignition and other switches and bulbs and heaters. Investigate the use of sensors and logic gates in home security systems or environmental and biological monitoring systems. Investigate the replacement of series/parallel switching in car electrics by And/Or logic gates. Research typical values of current and voltage in electricity distribution systems. Investigate factors affecting resistance. Research the values of resistance of electrical supply cables and flexes for high current appliances.	$V = IR$ Series circuit rules: $I_s = I_1 = I_2 = \ldots$ $V_s = V_1 + V_2 + \ldots$ Parallel circuit rules: $I_s = I_1 + I_2 + \ldots$ $V_s = V_1 = V_2 = \ldots$ $R_T = R_1 + R_2 + \ldots$
Gas laws and the kinetic model Knowledge of the kinetic model of a gas. Qualitative knowledge of the effects of varying	Observe a demonstration of the kinetic model using kinetic theory apparatus.	

pressure, volume or temperature on a fixed mass of an ideal gas. Awareness of applications of the kinetic model of a gas using knowledge of pressure, volume and temperature (for a fixed mass of an ideal gas).	Research the values of tyre pressures at different temperatures. Research the use of gas tanks in scuba diving. Research 'free diving' and consider the volume of air in free diver's lung. Research weather balloons. Calculate the difference in pressure inside and outside a pressurised aircraft cabin, and the forces acting on the fuselage of the aircraft. Research into the heating and cooling of gases.	
Waves and Radiation		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
Wave characteristics Comparison of longitudinal and transverse waves. Definition of frequency as the number of waves per second. Use of an appropriate relationship to solve problems involving frequency, number of waves and time. Identification of wavelength and amplitude of transverse waves. Use of an appropriate relationship to solve problems involving wave speed, frequency and wavelength.	Watch a video analysis of 'slinky' waves to determine characteristics. Watch computer simulations to determine characteristics. Measure the speed, wavelength and frequency of water waves moving along rainwater gutters or ripple tanks filled to different depths. Use frequency meters to measure frequency.	$f = \frac{N}{t}$ $v = f\lambda$ $d = \bar{v}t$

Use of an appropriate relationship to solve problems involving distance, speed and time for waves.		
Sound Analysis of sound waveforms including changing amplitude and frequency. Knowledge of methods of measurement of the speed of sound in air. Knowledge of sound level measurement, including decibel scale. Awareness of noise pollution and risks to human hearing. Knowledge of methods of protecting hearing. Awareness of noise cancellation as a means of reducing the risk of damage to hearing.	Observe oscilloscope patterns. Investigate voice recognition software. Measure the speed of sound in solids, liquids and gases. Measure typical sound levels in a building. Research the effects of exposure to different sound levels and the dangers of prolonged exposure to high sound levels. Investigate the absorption of sound by different materials. Research the technology used in modern hearing aids. Research the use of noise-cancelling headphones and noise-cancellation technology in Humvees and helicopters. Research practical uses of sonar, for example	

Awareness of applications of sonar and ultrasound. Awareness of sound reproduction technologies.	measuring the depth of water and finding shoals of fish. Research into the use of ultrasound in medical scanning, and in ranging devices. Experiment with the production of notes in a variety of musical instruments. Explore technology used to record and enhance sound.	
Electromagnetic Spectrum Knowledge of applications and hazards associated with electromagnetic radiations. Knowledge of approaches to minimising risks associated with electromagnetic radiations. Description of how invisible parts of the EM spectrum can be detected.	Research parts of the EM spectrum including: Gamma rays, X-rays, Ultraviolet radiation, visible light, Infrared radiation, Microwaves, Radio waves. Applications in industry or leisure. Typical jobs which would use the radiation. Possible hazards of the radiation. Safety precautions to be taken with the radiation. For example, sunglasses to protect from UV and IR. Detection of EM radiation: ♦ microwave leakage from electrical devices (eg ovens, TVs, mobile phones, tablet computers and Wi-Fi hubs ♦ display of pulses from a remote control handset on an oscilloscope using phototransistor, IR sensitive sheets or similar ♦ dye/paint sensitive to ultraviolet radiation	

Description of refraction in terms of change of direction (where angle of incidence is greater than 0˚).	♦ spectral analysis plot on digital camera display or photo editing software Light — application of lenses to correct long and short sight	
Nuclear radiation Knowledge of natural and artificial sources of nuclear radiation and associated medical and industrial applications. Consideration of the pros and cons of generating electricity using nuclear fuel. Comparison of risk due to nuclear radiation with risk due to other environmental hazards (eg global warming) and the management of these risks.	Discuss the arrangement of neutrons, protons and electrons in an atom. Research into sources and effects of nuclear radiation including natural sources (eg radon) man-made sources (eg plutonium), their effects on living things (eg leukaemia) and their effects on non-living things (scintillation, sparks between high voltages).	

Dynamics and Space		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
Speed and acceleration Use of an appropriate relationship to solve problems involving speed, distance, and time. Determination of average and instantaneous speed. Interpretation of speed-time graphs to describe motion including calculation of distance (for objects which are speeding up, slowing down, stationary and moving with constant speed.) Motion in one direction only.	Measure the average speed of trolley moving down a slope or along a level bench. Use light gates/motion sensors to measure speed. Measure the acceleration of a vehicle using two light gates and a stopwatch. Produce speed time graphs using motion sensors and appropriate computer software. Draw a speed time graph of a car's journey by measuring speed at different times from video of speedometer during journey.	$d = \overline{v}t$

Use of an appropriate relationship to solve problems involving acceleration, change in speed and time.	Discuss how light gates could be used in sports (timing races, measuring instantaneous and average speed). Determine the acceleration of sports cars, theme park rides and space vehicles from research data.	$a = \frac{\Delta v}{t}$
Relationship between forces, motion and energy Use of Newton's first law and balanced forces to explain constant speed for a moving object, making reference to frictional forces. Use of Newton's second law to explain the movement of objects in situations involving constant acceleration. Use of an appropriate relationship to solve problems involving force, mass and acceleration in situations where only one force is acting. Use of an appropriate relationship to solve problems involving weight, mass and gravitational field strength. Knowledge of the risks and benefits associated with space exploration including the challenges of re-entry to a planet's atmosphere and the use of thermal protection systems to protect spacecraft on re-entry.	Measure the forces needed to change the shape of an object, and the speed and direction of the motion of an object. Use an office fan to move low-friction trolley with a 'sail'. Use an office fan to change direction of light ball thrown into the air. Experiment with placing different weights onto all ball of plasticine and compare the changes in its shape. Investigate the relationship between mass and weight using a Newton balance. Use sandpaper or a rubber to demonstrate that friction converts movement energy to heat. Relate this to a spacecraft moving at high speed through the atmosphere of a planet during re-entry. Investigate the thermal conductivity of different materials.	$F = ma$ $W = mg$
Satellites Knowledge of the range of heights and functions of satellites in orbit around the earth, including	Investigate the relationship between orbital height and period by using computer simulations or data	

geostationary and natural satellites. Knowledge of the qualitative relationship between the altitude of a satellite and its period. Knowledge of the use of parabolic reflectors to send and receive signals. Use of the relationship between distance, speed and time applied to satellite communication. Awareness of a range of applications of satellites including telecommunications, weather monitoring, their use in environmental monitoring, and developing our understanding of the global impact of mankind's actions.	from internet. Investigate the uses of different satellites related to the orbital period or height and their potential impact on society. Investigate reflection from curved reflectors with ray boxes or microwave kit. Research the use of solar furnaces for heating water in developing countries and the potential social benefits.	$d = \bar{v}t$
Cosmology Description of planet, moon, star, solar systems, exo-planet, galaxy and universe. Awareness of the scale of the solar system and universe measured in light years. Awareness of space exploration and its impact on our understanding of the universe and planet Earth. Consideration of the conditions required for an exo-planet to sustain life.	Research data for solar system including mass, time to orbit the Sun, surface temperature range, number of moons, time for one rotation, etc and present data graphically or pictorially. Research the nature and scale of the universe (planet is part of a solar system; solar system is part of a galaxy) using computer simulations or internet search. Research data on galaxies, for example the Whirlpool galaxy, possible using support from the Royal Observatory Edinburgh Galaxies Project or Galaxy Zoo software. Investigate whether exo-planets could support life, possibly using support from the Royal Observatory Edinburgh Exo-planets Project.	