Co-teaching Entry Level Certificate and GCSE Combined Science: Trilogy

Physics

Component 5 – Energy, forces and the structure of matter
Component 6 – Electricity, magnetism and waves

This resource provides guidance for co-teaching our new Entry Level Certificate (ELC) Science and Foundation Tier GCSE Combined Science: Trilogy specifications. Our ELC is designed for students who may not achieve a grade 1, but you can also use it as a motivational tool to build confidence for your Foundation Tier students.

Physics: Component 5 – Energy, forces and the structure of matter

ELC Outcomes	Summary of content covered in ELC	Same theme covered in Combined but extra content	New content on same topic	Rest of Combined Foundation content
1. Changes in energy storage	When a kettle boils the way energy is stored in a simple system changes. Not all the changes are useful. Different devices have different energy wastages.	6.1.1.1 Energy stores and systems: calculations required.	6.1.1.2 Changes in energy: kinetic energy; elastic potential energy; gravitational potential energy. 6.1.1.3 Energy changes in systems: Specific heat capacity	6.8 Key ideas: • Models • Cause and effect • Action at a distance • Proportionality • Use of mathematical form 6.1.1.4 Power: Equation and calculations. 6.3.2.1 Internal energy: changes of state 6.3.2.2 Temperature changes in a system and specific heat capacity: equations and calculations. 6.3.2.3 Changes of heat and specific latent heat: equations and calculations. 6.3.3.1 Particle motion in gases

Practical development	Circus (real or virtual) of everyday devices in use eg kettle, hairdryer, vacuum cleaner	Required practical 14: an investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored.		
2. Energy transfers and efficiency	Energy cannot be created or destroyed. In any energy transfer, some energy is stored in less useful ways and is described as 'wasted' energy. Unwanted energy transfers can be reduced. The rate of cooling of a building is affected by the thickness and thermal conductivity of its walls. The higher the thermal conductivity of a material, the higher the rate of energy transfer by conduction across the material.	6.1.2.1 Energy transfers in a system: more detail.	6.1.2.2 Efficiency Equation and calculations	6.3.1.1 Density of materials Required practical 17: use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid object and liquids.
Practical development	Leslie's cube to demonstrate difference in surface cooling. Compare cooling of drinks with lid on/off.			

	Investigate factors that affect the rate of cooling of a container of water eg surface area, initial temperature, types of insulation, colour of the container. Investigate the thermal conductivity of different materials eg which is better for a saucepan handle: wood or metal?			
3. Energy resources	Define 'fuel' and 'fossil fuel. Energy resources are renewable or non-renewable.	6.1.3 National and global energy resources: additional detail.		
Practical development	Demonstrate electricity generation by building models of windmill (using hairdryer) or water mill to turn a turbine and generate a voltage. Investigate the relationship between the distance from a light source and a solar (photoelectric) cells on the voltage generated.			

4. Types of forces	Forces are either a push or pull acting on an object due to an interaction with another force. Forces are either: contact forces or non-contact forces	6.5.1.2 Contact and non-contact forces: reference to vectors.	6.5.1.1 Scalar and vector quantities 6.5.1.3 Gravity: equations and calculations	6.5.1.4 Resultant forces: free body diagrams
Practical development	Use newton meters to experience a range of pushes/pulls for lab/everyday objects Attraction/repulsion of magnets; attraction of magnetic materials eg paperclips/iron filings			
5. Effects of forces	Work is done when a force causes an object to move through a distance. (No calculations needed) When work is done against frictional forces acting on an object, there is a rise in temperature.	6.5.2 Work done and energy transfer: additional detail; equations and calculations.	6.5.3 Forces and elasticity: equations and calculations	
Practical development	Investigate how different surface affect the amount of friction on a moving block.	Required practical 18: Investigate the relationship between force and extension for a spring.		

6. Speed	Speed is measured by the distance travelled in a certain time. The units for speed as metres per second, kilometres per hour and miles per hour. Calculate average speed using the equation: *speed = distance/time*	6.5.4.1.2 Speed: additional detail	6.5.4.1.1 Distance and displacement: scalar and vector quantities. 6.5.4.1.3 Velocity: distinguish between scalar and vector quantities. 6.5.4.1.4 The distance-time relationship: graphical representations	6.5.4.1.5 Acceleration: Equations and calculations
	Investigate how the speed of a trolley (or model car) changes as it rolls down a slope.			
7. Stopping distances	The stopping distance of a vehicle is the sum of the distance the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance). For a given braking force, the greater the speed of the vehicle, the greater the stopping distance.	6.5.4.3.1 Stopping distances		6.5.4.2.1 Newton's First Law 6.5.4.2.2 Newton's Second Law Required practical 19: Investigate the effect of varying the force on the acceleration of an object of constant mass and the effect of varying the mass of an object on the acceleration produced by a

				constant force. 6.5.4.2.3 Newton's Third Law
8. Reaction times and stopping distances	A typical reaction time for a person ranges from 0.5s to 0.9s. A driver's reaction time can be affected by tiredness, drugs and alcohol and distractions.	6.5.4.3.2 Reaction time: evaluation of data.	6.5.4.3.4 Factors affecting braking distance 2: force and kinetic energy	
Practical development	Investigate factors that affect human reaction time eg tiredness, distraction, practice**.**			
9. Weather conditions and braking distances	The braking distance of a vehicle can be affected by adverse road and weather conditions and poor condition of the vehicle.	6.5.4.3.3 Factors affecting braking distance 1: estimating distances		
10. Radioactivity	Some atomic nuclei are unstable and produce ionising radiation. Nuclear radiation may be emitted as: • alpha particles • beta particles	6.4.1.1 The structure of an atom: additional detail of atomic structure. 6.4.2.1 Radioactive decay and nuclear radiation: additional detail of the types of radiation.	6.4.1.2 Mass number, atomic number and isotopes. 6.4.1.3 The development of the model of the atom (*cf* chemistry)	6.4.2.2 Nuclear equations 6.4.2.3 Half-lives and the random nature of radioactive decay

	• gamma rays These have different penetration of materials and range in air. The uses and dangers. associated with the three types of radiation.	6.4.2.4 Radioactive contamination: additional information.		

Physics: Component 6 – Electricity, magnetism and waves

ELC Outcomes	Summary of content covered in ELC	Same theme covered in Combined but extra content	New content on same topic	Rest of Combined Foundation content
1. Current in a circuit	Current is a flow of electrical charge which can be measured using an ammeter in series. Voltage is measured using a voltmeter in parallel across a component. The current in a component depends on the resistance in the circuit.	6.2.1.2 Electrical charge and current: additional detail and equation. 6.2.1.3 Current, resistance and potential difference: additional detail and equation	6.2.1.1 Standard circuit diagram symbols	6.8 Key ideas: • Models • Cause and effect • Action at a distance • Proportionality • Use of mathematical form 6.2.1.4 Resistors: ohmic conductors, diodes, thermistors 6.2.2 Series and parallel circuits: resistance calculations
Practical development	Build series circuits to measure current through a variety of components. Investigate which materials are the best electrical conductors.	Required practical 15: use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include the length of a wire at constant temperature and combinations of resistors in series and parallel. Required practical 16: use circuit diagrams to construct appropriate circuits to investigate the I-V characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature.		
2. d.c. and a.c. current	Direct current is supplied by cells and batteries. Mains electricity is	6.2.3.1 Direct and alternating potential difference		

	alternating current. UK mains electricity has a frequency of 50Hz and is 230V.			
Practical development	Compare the pattern shown on an oscilloscope for d.c. and a.c. supply.			
3. Wiring a plug	The colour-coding for three-core flex and the appropriate terminal for each wire in a plug. The earth wire protects the user; the fuse protects the appliance. Double-insulated appliances do not need an earth wire.	6.2.3.2 Mains electricity: additional detail.		
Practical development	Wire a standard 3 pin plug correctly. Investigate how fuse wire melts when the identified current is exceeded			
4. Energy transfer in electrical appliances	Domestic electricity meters measure the amount of energy used. The unit for power (W). Heating devices have the highest power ratings. The unit used in a domestic electricity meter to measure energy is the	6.2.4.1 Power: Equations and calculations. 6.2.4.2 Energy transfers in everyday appliances: Equations and calculations	6.2.4.3 The National Grid	

	kilowatt-hour (kWh).			
Practical development	Reading of meters to produce meaningful and valid observations. Comparison of the energy usage of small household electrical appliances using a joulemeter.			
5. Magnets	The poles of a magnet are where the magnetic forces are strongest. Like poles repel and unlike poles attract; these are non-contact forces. There is a pattern of magnetic fields between two magnets.	6.7.1.1 Poles of a magnet 6.7.1.2 Magnetic fields: additional detail.		
Practical development	Identify the N and S poles of bar magnets using a suspended magnet to show attraction and repulsion. Use a compass to identify the field pattern around a single and then paired bar magnets. Construct a ‘magnetic toy’			

	of floating magnets using circular 'holed' magnets and wooden base and rod.			
6. Electromagnets and solenoids	Current in a wire produces a magnetic field around the wire. Increasing the current increases the strength of a magnetic field. A simple electromagnet can be made from a solenoid and an iron core. Electromagnets are used in relays and scrapyards.	6.7.2.1 Electromagnetism: additional detail		
Practical development	Use a plotting compass to identify the magnetic field round a current-carrying wire. Investigate how the strength of an electromagnet changes. Investigate factors that affect the strength of an electromagnet.			

7. Longitudinal and transverse waves	Waves transfer energy not physical materials. Waves may be transverse or longitudinal. Sound waves need a medium (material) to travel through.	6.6.1.1 Transverse and longitudinal waves		
Practical development	Class 'Mexican wave' demonstration. Practical demonstrations: Slinky (longitudinal) Rope (transverse) Bell in (evacuated) jar			
8. Wave properties	A transverse wave can be described by its wavelength and amplitude. The wave equation; the correct units for wave speed, frequency and wavelength	6.6.1.2 Properties of waves: equations and calculations; measurement of speed of waves.		
Practical development	Demonstrate wave shapes using oscilloscope. Use oscilloscope, frequency generator, loudspeaker to relate frequency to changes in pitch and to relate amplitude to changes in volume.	Required practical 20: make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements.		

9. The electromagnetic spectrum	The order of the spectrum (but not the values of wavelength or frequency). The risks associated with ultraviolet waves, X-rays and gamma rays.	6.6.2.1 Types of electromagnetic waves 6.6.2.3 Properties of electromagnetic waves 2: additional detail.	6.6.2.2 Properties of electromagnetic waves 1: ray diagrams.	
Practical development	Investigate the effectiveness of sunscreens in absorbing u.v radiation using u-v sensitive beads or microscope slides and sunscreens	Required practical 21: investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.		
10. Uses of the electromagnetic spectrum	The seven components of the e-m spectrum. The uses of electromagnetic radiation.	6.6.2.4 Uses and applications of electromagnetic waves		
Practical development	Circus of exemplars of e-m radiation eg radio; microwave oven; infra-red heater eg toaster; light source and prism; UV light and tonic water; UV-visible pens; sample X-ray. Investigate microwaves to find which materials block them (eg apple). Investigate light travelling			

	down an optical fibre over a distance. Investigate the shielding of a mobile phone or remote control device. Investigate the range over which a Bluetooth device is effective.			