

# Light and Electricity

Core Lesson 1	Core lesson 2	Option lesson 2a	Core Lesson 3	Option lesson 3a	Option lesson 3c	Core Lesson 4
1 ½ hours	1 ¼ – 1 ½ hours	30 minutes + independent study	1 – 1 ¼ hours	20-30 minutes	1 hour + project time	1 ¼ - 1 ½ hours
Sound transmission and reception	Sound waves	Tuning technology	Light reflection and refraction	Refraction	Pinhole camera	Coloured light
<p><b>Physics Objectives</b> Pupils review the idea that vibrations cause sound and consider how the vibrations are transmitted from the vibrating object through a medium to a receiver, and apply a simple model of energy transfer.</p>	<p><b>Physics Objectives</b> Pupils extend the model of energy transfer by vibrating particles to the idea of sound waves as waves of pressure. The frequency of sound waves is related to the pitch, and amplitude to the volume. These are varied on musical instruments, producing different sounds.</p>	<p><b>Physics Objectives</b></p>	<p><b>Physics Objectives</b> Pupils understand that objects may absorb, transmit or reflect light. They investigate the laws of reflection and how light refracts at the boundary between two different materials due to a change in speed.</p>	<p><b>Physics Objectives</b></p>	<p><b>Physics Objectives</b></p>	<p><b>Physics Objectives</b></p>
<p><b>Key concepts and processes</b> Pupils investigate how a chosen sound system works in terms of energy transfer and how the vibrations are transmitted. They explain their findings to the class and identify ways in which it could be adapted for different audiences.</p>	<p><b>Key concepts and processes</b> Pupils plan and carry out an enquiry into how musical instruments make sounds of different pitch and volume, and how to relate pitch/frequency and volume/amplitude to oscilloscope traces.</p>	<p><b>Key concepts and processes</b> Pupils compare the accuracy of electronic tuners with tuning by ear, appreciating that a small pitch offset is caused by a frequency offset. They produce a consumer report comparing features such as speed, cost and accuracy of the different tuners.</p>	<p><b>Key concepts and processes</b> Pupils plan and carry out an enquiry into reflection and refraction of light. They measure angles of incident rays, recording their results in tables and using their evidence to draw conclusions, deriving the laws of reflection and observing evidence for refraction.</p>	<p><b>Key concepts and processes</b> Pupils investigate the physics behind the 'rising penny', using ray diagrams to communicate their explanations.</p>	<p><b>Key concepts and processes</b> Pupils build and use a pinhole camera, explaining image formation using ray diagrams. They predict and explore how the image is altered, for example by changing the hole diameter or number of holes.</p>	<p><b>Key concepts and processes</b> Pupils build and use a pinhole camera, explaining image formation using ray diagrams. They predict and explore how the image is altered, for example by changing the hole diameter or number of holes.</p>
<p><b>PLTS</b> - Invite feedback and deal positively with praise, setbacks and criticism by listening attentively to feedback on their presentations and noting key suggestions for developing their future work of this type</p>	<p><b>PLTS</b> - Connect their own and others' ideas and experiences in inventive ways by trying out different sounds on a microphone attached to an oscilloscope to see the shape (amplitude, frequency) of the screen traces</p>	<p><b>PLTS</b> - Analyse and evaluate information, judging its relevance and value, by deciding on which factors to include in their product report</p>	<p><b>PLTS</b> - Support conclusions using reasoned arguments and evidence by deducing the laws of reflection with reference to their results of measured angles</p>	<p><b>PLTS</b> - Support conclusions, using reasoned arguments and evidence by using ray diagrams and appropriate vocabulary to explain the penny 'levitation'</p>	<p><b>PLTS</b> - Try out alternatives or new solutions and follow ideas through by investigating how the image can be altered in the pinhole camera</p>	<p><b>PLTS</b> - Try out alternatives or new solutions and follow ideas through by investigating how the image can be altered in the pinhole camera</p>
<p><b>Technician's notes</b> Explore: string telephones (see Option 1b in Unit 7), microphone attached to tape recorder with loudspeaker (or a PC microphone), battery operated radio, clamped rulers; dismantled old style telephone Explain: bell jar and vacuum pump apparatus (safety screen should be placed in front of evacuated jar); resonance pendulums - Plasticine, clamp stands, string; tuning fork, suspended ping-pong ball Extend: as Explore plus microphones, mp3 players with earphones/mini speakers, model ear</p>	<p><b>Technician's notes</b> Explore: sound sources - tuning forks and boxes; plastic boxes with rubber bands stretched across; pan pipes, test tube set filled with water to different heights, swanee whistle Explain: slinky spring, microphone attached to oscilloscope or datalogger Extend: a selection of (tuned) musical instruments: guitars, recorders, flutes, other wind and stringed instruments, microphone attached to oscilloscope or datalogger</p>		<p><b>Technician's notes</b> Engage: slide/digital projector with slide of scenery or portrait, selection of large surfaces for reflecting the image (mirror, polished metal, bathroom tile, paper) Explore and Extend: white paper to cover benches, ray boxes with slits, plane mirrors, transparent, translucent and opaque materials, rectangular and semicircular glass or Perspex blocks, rulers and protractors, light meters (optional)</p>			

**Assessment:** During each lesson each student should assess their own level using the pupil speak level ladders and show their partner where the evidence is for that level. They should record this in the grid at the front of the book. The member of staff should then assess the level of a maximum of 2 students work each lesson. At the end of each lesson there will be an end of topic test to check the content level.

**Homework:** For each topic there is a task booklet that students should use for homework.

Option lesson 4a	Core Lesson 4	Core Lesson 5	Option lesson 5a	Core Lesson 5	Option lesson 5a	Core lesson 6
20-40 minutes + independent study	1 ¼ - 1 ½ hours	1 hour	20-40 minutes + independent study	1 hour	20-40 minutes + independent study	1 – 1 ½ hours
Pioneers of light	Coloured light	Sound and Music	The recording industry	Sound and Music	The recording industry	Current and voltage
<b>Physics Objectives</b>	<b>Physics Objectives</b> Pupils understand that white light consists of a spectrum of light of different colours. They explain the effects of coloured filters in terms of energy absorption and explain how objects appear in different coloured light in terms of reflection and absorption.	<b>Physics Objectives</b> Pupils are introduced to the idea that a single or 'pure' tone produces a simple waveform, while adding sounds or using more 'complex' instruments (with more frequency overtones or harmonics) gives the note a different 'quality' and produces a more complex waveform.	<b>Physics Objectives</b>	<b>Physics Objectives</b> Pupils are introduced to the idea that a single or 'pure' tone produces a simple waveform, while adding sounds or using more 'complex' instruments (with more frequency overtones or harmonics) gives the note a different 'quality' and produces a more complex waveform.	<b>Physics Objectives</b>	<b>Physics Objectives</b> Pupils measure voltage and current at different points in simple series circuits to build n understanding of current as rate of flow of charge and voltage as a difference in electrical energy between 2 parts of a circuit.
<b>Key concepts and processes</b> Pupils devise a research question in an area of their own choosing connected with light, and an approach to answering the question (including selecting information sources). They produce a report or presentation based on their research, describing the development of new explanations or technological applications in terms of the underpinning scientific ideas	<b>Key concepts and processes</b> Pupils plan and carry out an enquiry into the effects of coloured filters and coloured lights on the appearance of coloured objects. They explain these phenomena using scientific vocabulary and diagrams.	<b>Key concepts and processes</b> Pupils communicate their findings, using appropriate descriptive language and drawings for what they hear and see.	<b>Key concepts and processes</b> Pupils devise a research question in an area of their own choosing and describe technological applications in terms of the underpinning scientific ideas.	<b>Key concepts and processes</b> Pupils communicate their findings, using appropriate descriptive language and drawings for what they hear and see.	<b>Key concepts and processes</b> Pupils devise a research question in an area of their own choosing and describe technological applications in terms of the underpinning scientific ideas.	<b>Key concepts and processes</b> Pupils communicate ideas about current and voltage as they explain the readings in their circuits, using the correct terminology.
<b>PLTS</b> - Identify questions to answer and problems to resolve by choosing a suitable area to study, and suitable lines of enquiry	<b>PLTS</b> - Evaluate experiences and progress to inform future progress by identifying the appearance of primary coloured objects under primary lighting conditions to inform predictions about the likely appearance of objects under secondary colours	<b>PLTS</b> - Assess themselves and others, identifying opportunities and achievements by matching heard sounds to visual waveforms, and presenting a matching game to other pupils	<b>PLTS</b> - Identify questions to answer and problems to resolve by choosing a suitable area to study within the recording industry, and suitable lines of enquiry	<b>PLTS</b> - Assess themselves and others, identifying opportunities and achievements by matching heard sounds to visual waveforms, and presenting a matching game to other pupils	<b>PLTS</b> - Identify questions to answer and problems to resolve by choosing a suitable area to study within the recording industry, and suitable lines of enquiry	<b>PLTS</b> – Support conclusions, using reasoned arguments and evidence, by using the ideas the idea of energy transfer in components with differing resistance to explain different voltage drops across components in a circuit.
	<b>Technician's notes</b> Engage: three slide projectors with slits, ray boxes or floodlights (ask theatre department) with blue, green and red filters Explore and Extend: ray boxes with slits, prisms, paper or objects of a single colour (or colour palette testers), primary and secondary colour filters, 'dark boxes' (e.g. cardboard shoe boxes, covered inside with black paper, with a small viewing hole and an opposite hole to shine coloured light in) A good blackout is needed in this lesson.	<b>Technician's notes</b> Engage and Explain: keyboards and/or tuned percussion instruments Explain and Extend: as above, plus microphones linked to oscilloscopes or PCs, to display waveforms		<b>Technician's notes</b> Engage and Explain: keyboards and/or tuned percussion instruments Explain and Extend: as above, plus microphones linked to oscilloscopes or PCs, to display waveforms		<b>Technician's notes</b> Circuit boards, 1.5V batteries and holders, buzzers, leads, crocodile clips, lengths of nichrome wire, ammeters, voltmeters

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Option lesson 6a	Option lesson 6b	Core Lesson 7	Option lesson 7a	Option lesson 7b
20-30 minutes + independent study	30-40 minutes	1 ¼ - 1 ½ hours	30-40 minutes	20-30 minutes
History of electrical technologies	Controlling current and voltage in circuits	A model for current and voltage	Making and evaluating a water flow model	Devices that use electromagnets
<b>Physics Objectives</b>	<b>Physics Objectives</b>	<b>Physics Objectives</b> Pupils make parallel circuits to light different combinations of bulbs, measuring the current and voltage at different points. They use models for current flow and energy transfer to help explain their results.	<b>Physics Objectives</b>	<b>Physics Objectives</b>
<b>Key concepts and processes</b> Pupils devise a research question about the development and use of electrical technologies in history. They produce a report or presentation explaining the benefits and some of the consequences of uses of technology, for an audience of primary school pupils.	<b>Key concepts and processes</b> Pupils design and make circuits to solve specific problems, using switches, bulbs and variable resistors in series and parallel circuits	<b>Key concepts and processes</b> Pupils communicate the results of their circuit building. They explain using models (such as the water analogy, or energy conservation) to account for the varying currents and voltages	<b>Key concepts and processes</b> Pupils make and try out a water pumping system as a physical model of the flow of current in a circuit. They evaluate the strengths and weaknesses of different models for explaining current flow and energy transfer in circuits.	<b>Key concepts and processes</b> Pupils apply knowledge of the different stages of how an electromagnet works to explain how for example a car starter motor or door bell works, and communicate this logically as a flowchart
<b>PLTS</b> - Plan and carry out research, appreciating the consequences of decisions, by deciding what information they will need to compile a report on an aspect of the development and use of electricity, and taking the appropriate steps to collect it	<b>PLTS</b> - Review progress, acting on the outcomes, by considering the success of their circuits in solving the problems, and (perhaps) deciding to plan with circuit diagrams or using software	<b>PLTS</b> – Support conclusions, using reasoned arguments and evidence, by accounting for the measurements of current and voltage in terms of current dividing at circuit junctions, and the water flow model for energy transfer in circuits.	<b>PLTS</b> - Support conclusions, using reasoned arguments and evidence, by explaining how the model circuit is an analogy of a real circuit and where this analogy fails	<b>PLTS</b> - Ask questions to extend their thinking by thinking about how to apply what they have learnt to an unfamiliar situation
		<b>Technician's notes</b> 1.5V batteries, 2.5V lamps and holders, leads, ammeters, voltmeters and switches.		

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