Light and Electricity

Core Lesson 1	Option lesson 1a	Core lesson 2	Option lesson 2a	Core Lesson 3	Option lesson 3a	Option lesson 3b
1 ½ hours	30 minutes + independent study	1 ¼ – 1 ½ hours	30 minutes + independent study	1 – 1 ¼ hours	20-30 minutes	40 minutes
Sound transmission and reception	Hearing aids	Sound waves	Tuning technology	Light reflection and refraction	Refraction	Depth perception
Physics Objectives 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.	**Physics Objectives**	**Physics Objectives** 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.	**Physics Objectives**	**Physics Objectives** 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.	**Physics Objectives**	**Physics Objectives**
Key concepts and processes 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.	**Key concepts and processes** Pupils carry out a focused research project on how hearing aids work, and communicate scientific information in a format appropriate to a young audience.	**Key concepts and processes** 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.	**Key concepts and processes** 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.	**Key concepts and processes** Pupils plan and carry out an enquiry into reflection and refraction of tight. 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.	**Key concepts and processes** Pupils investigate the physics behind the 'rising penny', using ray diagrams to communicate their explanations.	**Key concepts and processes** Pupils plan and carry out an investigation into binocular vision, using scientific knowledge to explain their results.
PLTS - 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	**PLTS** - Identify improvements that would benefit others by suggesting (in the leaflet produced) appropriate courses of action for peers who suffer hearing loss	**PLTS** - 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	**PLTS** - Analyse and evaluate information, judging its relevance and value, by deciding on which factors to include in their product report	**PLTS** - Support conclusions using reasoned arguments and evidence by deducing the laws of reflection with reference to their results of measured angles	**PLTS** - Support conclusions, using reasoned arguments and evidence by using ray diagrams and appropriate vocabulary to explain the penny 'levitation'	**PLTS** - Collaborate with others to work towards common goals by working in pairs and then as a class to collect a large sample of data
Technician's notes Explore: string telephones (see Option 1b in Unit 7I), 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		**Technician's notes** 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		**Technician's notes** 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)		

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 3c	Core Lesson 4	Option lesson 4a	Option lesson 4b	Core Lesson 5	Option lesson 5a	Core lesson 6
1 hour + project time	1 ¼ - 1 ½ hours	20-40 minutes + independent study	20-40 minutes + independent study	1 hour	20-40 minutes + independent study	1 – 1 ½ hours
Pinhole camera	Coloured light	Pioneers of light	Optical illusions	Sound and Music	The recording industry	Magnetism
Physics Objectives	**Physics Objectives** 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.	**Physics Objectives**	**Physics Objectives**	**Physics Objectives** 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.	**Physics Objectives**	**Physics Objectives** Pupils extend the basic idea that magnets exert forces of attraction on magnetic materials to consider the regions where these forces act at a distance, i.e. magnetic fields. They use lines to show the direction of force and where the force is strongest.
Key concepts and processes 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.	**Key concepts and processes** 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.	**Key concepts and processes** 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	**Key concepts and processes** Pupils investigate a variety of optical illusions and carry out a focused research project in an area of their own choosing. They communicate scientific explanations of their findings.	**Key concepts and processes** Pupils communicate their findings, using appropriate descriptive language and drawings for what they hear and see.	**Key concepts and processes** Pupils devise a research question in an area of their own choosing and describe technological applications in terms of the underpinning scientific ideas.	**Key concepts and processes** Pupils plan and carry out an enquiry into the patterns of magnetic fields produced by different permanent magnets. They select and use appropriate means of recording the field strength and shape.
PLTS - Try out alternatives or new solutions and follow ideas through by investigating how the image can be altered in the pinhole camera	**PLTS** - 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	**PLTS** - Identify questions to answer and problems to resolve by choosing a suitable area to study, and suitable lines of enquiry	**PLTS** - Organise time and resources, prioritising actions by planning an approach and producing a quality presentation on time	**PLTS** - Assess themselves and others, identifying opportunities and achievements by matching heard sounds to visual waveforms, and presenting a matching game to other pupils	**PLTS** - Identify questions to answer and problems to resolve by choosing a suitable area to study within the recording industry, and suitable lines of enquiry	**PLTS** - Try out alternatives or new solutions and follow ideas through, by using more than one way of investigating a magnetic field
	Technician's notes 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.			**Technician's notes** Engage and Explain: keyboards and/or tuned percussion instruments Explain and Extend: as above, plus microphones linked to oscilloscopes or PCs, to display waveforms		**Technician's notes** Bar magnets, magnetic and non-magnetic materials for testing (such as paper clips, coins), plain paper, plotting compasses, neodymium magnets, different sized paper clips, cotton thread, clamp stands, rulers Check that the compass needles all point north - they are easily remagnetised. Ensure no large iron or steel objects are close when pupils plot their field, as these can affect the results.

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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 6a	Option lesson 6b	Core Lesson 7	Option lesson 7a	Option lesson 7b
20-30 minutes + independent study	30-40 minutes + independent study	20-40 minutes + independent study	30-40 minutes + independent study	20-30 minutes
Investigating magnetic toys	Magnets in audio electronics	Electromagnetism	From motors to particle accelerators	Devices that use electromagnets
Physics Objectives	**Physics Objectives**	**Physics Objectives** Pupils understand that an electric current causes a magnetic field, and discover how this can be changed by increasing the current, number of turns of wire and the amount of iron in the core.	**Physics Objectives**	**Physics Objectives**
Key concepts and processes Pupils investigate a selection of magnetic toys on the market, and design a new product. They communicate their findings for a different audience, possibly using ICT.	**Key concepts and processes** Pupils carry out a research enquiry to find out about how magnets are used in the fast-changing audio world. They select relevant sources of information and communicate their findings, possibly using ICT.	**Key concepts and processes** Pupils choose how they will test the strength of the electromagnet and plot its field and take steps to carry out their practical work safely. They evaluate how their plan could be improved.	**Key concepts and processes** Pupils carry out a research enquiry to find out about how electromagnets are used in different applications, and the importance and implications of their use for example in medical imaging. They select relevant sources of information and communicate their findings, possibly using ICT.	**Key concepts and processes** 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
PLTS - Communicate their learning in relevant ways for different audiences, by writing (a) instructions for their game's players, and (b) a scientific report on the principles of magnets that underpin the game for (fellow scientist) peers	**PLTS** - Invite feedback and deal positively with praise, setbacks and criticism, by listening to comments from their peers on the format and information sources in their presentation	**PLTS** - Plan and carry out research, appreciating the consequences of decisions, by planning what variables they will use in their enquiry, and as a result of the plan, appreciate what factors must be kept the same	**PLTS** - Generate ideas and explore possibilities by deciding on a line of enquiry to pursue and independently seeking useful information to inform the enquiry	**PLTS** - Ask questions to extend their thinking by thinking about how to apply what they have learnt to an unfamiliar situation
		Technician's notes Low voltage, variable do power packs, crocodile clips, heat-resistant mats, connecting wires, wooden dowel, large nails, insulated winding wire cut to 1-metre lengths with ends stripped, digital ammeter, plotting compasses, paper clips of various sizes, graph and plain paper Pupils should be warned to take care that the wires do not get too hot. Fumes from burning insulation are harmful. Pupils should turn off the power supply immediately if the insulation feels hot.		