National Curriculum Objectives:
(Statutory Requirements)

a) associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit

b) compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches

c) use recognised symbols when representing a simple circuit in a diagram.

Experimental and investigative work focuses on:

Planning an investigation:	**Obtaining and evaluating evidence:**
1. Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.	2. Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate. 3. Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs. 4. Using test results to make predictions to set up further comparative and fair tests. 5. Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations. 6. Identifying scientific evidence that has been used to support or refute ideas or arguments.

Most children will:
Suggest ways of changing the components within a circuit; draw circuit diagrams and construct circuits from diagrams using conventional symbols; set up a circuit which can be used to investigate an idea and use knowledge about electrical conductors and insulators to answer questions about circuits

Some will progress less and will:
Recognise conventional symbols for some electrical components and construct some working circuits with specified components
Others will progress further and will also:
Interpret more complex circuit diagrams.

Key vocabulary:

Previously taught: bulb, buzzer, appliance, battery, switch, circuit, connection, mains, break, brighter, metals, plastic, motor, electrical conductor, electrical insulator.
New:
cell, circuit symbol, circuit diagram.

Session	Learning Objectives	Introduction	Main activity	Application and review	Resources
1	**To understand voltage and current within electrical circuits.** **I understand what happens when I flick a switch and the light comes on.** **Assessment : a**	**Teach chn the knowledge:** Introduce the new topic and explain that we are going to be revising their understanding of electricity and circuits from Year 4 and thinking about the following question: ***Why when I flick a switch, does the light go on?*** Show chn the full range of electricity/circuit components on each table - range of bulbs, batteries, battery holders, different types of switches, crocodile clips, wires of different thicknesses etc. How many of the components have the chn seen before? Can they name them? Examine construction of the materials that the different components are made of (metal/non-metal) Why are the materials appropriate? Discuss thoughts, recapping ideas about electrical insulators and conductors. Look closely at bulb. Identify the filament and explain that the wire is so thin that the electric current has to work hard to pass through it = heat (bulb glows white hot). Children to draw and label. (emerging children can be given a diagram)	**Teaching the understanding:** Ask the children to build a circuit with the equipment provided to include a switch. Encourage the children to verbalise how it enables the light bulb to light up. What is the function of the battery wires, bulb and switch? (Discuss the need for complete circuits, conducting materials, a power source and switches to control the circuit.) Ask the children to draw their finished circuit and describe how it enables the light bulb to light. Children to record the function of the battery, bulb, wires and switch. (Emerging to use flipchart page and match component to its function). So what is it about the materials used and the construction of the components that means that a light bulb lights when a switch is operated? Use drama to demonstrate to the children. Ensure the chn understand that when the switch is pressed, copper contacts are closed and complete a circuit. Electricity flows through the wires and through the fine wire filament of the bulb, heating it up so much that it glows. Pressing the switch to turn the light off breaks the circuit by creating an air gap that the electricity cannot cross. Create a human circuit with the chn. Have two circles as the edges of the wires, a child as the battery, a child as the bulb (wearing a bib) and a child as a switch. Join feet. Have some children as loose electrons within the wires. They are there all the time but when you have a complete circuit with a power source (battery) the current (electrical charge) can flow because the battery is the pushing force. Explain this to the children using the teachers notes provided. With a push from the battery the	Discuss other uses of electricity to identify how useful electricity is and the different things it can do (production of light, sound and heat).	Electrical components Matching electrical components and description sheet.

		Create a list of vocabulary on the flipchart (including conductor and insulator).	electrons can slowly move around the circuit. When they reach the bulb it resists their flow and they have to crawl through. Can the chn want to add more to their explanation?		
Session	Learning Objectives	Introduction	Main activity	Application and review	Resources
2	**To identify and use the correct symbols for electrical components within circuit diagrams.** *I can correctly identify circuit diagram symbols and use circuit diagrams to create working circuits.* *Assessment : c*	Recap learning from last lesson. Discuss the importance of symbols. What is a symbol? Explain that drawings of complex circuits can be simplified using symbols in circuit diagrams. However we need to understand what the symbols stand for. Discuss terminology of cell verses battery (a cell is a single power source whereas a battery is made up of one or more cells to give the desired power). Chn match symbol image and description. Stick them together in their book. In pairs chn play a game of getting to know the symbols. Person A draws a symbol on a post-it and without person B seeing, sticks it to their head. Person B asks questions like 'Do I spin when powered in a circuit?' or 'Does my symbol have a circle in it?' Reinforce why it is important that all the chn use the same symbol for each component (everyone	Take a look at some of the circuits created in the previous session. How would these look recorded as circuit diagrams? With the help of the chn, show how to draw the circuit diagram with the conventional symbols (ensure a ruler is used for straight line and that there are no gaps). Explain that diagrams make it easier to see what is connected to what. Give chn a picture of a circuit from yesterday's lesson and ask them to stick it in and draw the circuit diagram for it. Extn: give the chn a picture of a circuit diagram and ask them to make the circuit from the diagram.	Discuss the range of symbols that surround us in our everyday lives- road signs, clothes labels, logos etc. Are they easy to understand? Are there any in and around school that you need explaining?	Pictures of circuits. Pictures of circuit diagrams Matching cards Post-its. learningcircuits.co.uk

		can recognise what the symbol means, symbols are easier to draw)			
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3	**To apply understanding of circuits** *I can recognise when a circuit will work and when it will not.* *I can build circuits using circuit diagrams to test my ideas* *Assessment : a,c*	Pick up any misconceptions/ mistakes from the previous session about drawing circuit diagrams (breaks in the circuits, symbols placed the wrong way in the diagram, where the chn have placed the components in the diagrams etc). Revise the use of symbols for the drawing of circuit diagrams. Why are they important? Play a game of circuit symbol bingo either in groups or as a whole class.	**Teaching the understanding of current and voltage:** Recap understanding of current and voltage. Reinforce again using more drama. *Position one child in a space next to a large bucket of balls. Tell them that they are the cell in the circuit. Children should stand in a line with their legs shoulder-width apart for the wires. Their toes should touch the toes of the other 'wire children' next to them. Remind the children that complete circuits are needed for a current to pass around the circuit and batteries are needed to provide the 'push'. Now add a bulb (another child in a coloured bib) to the circuit. As the circuit is completed the battery should start passing the balls from their bucket in one direction. As the balls reach the bulb they should show that they are lit in some way – broad smile or raised hands above head. Remind that if the circuit is broken at any point (one person closes legs together) the balls should stop being passed and the bulb should go out! Add in switches and more batteries. Discuss what happens as you increase the voltage (use larger voltage battery or more than one battery – more push, brighter bulbs- the greater the current, the harder it works). Discuss using the wrong components- too higher voltage for the bulb.* **Applying the understanding of current and voltage:** Together as a class look at some examples of circuits and ask the chn to explain what will happen when the power is turned on. Will the circuit work or not? Why? In each case ask the chn what would be required (if anything) to make the circuit work? Chn to use 'Will it work' sheet. Chn to write explanations as to whether each circuit will work and say why/why not using their understanding of complete circuits, voltage and current.	Were there any surprises- circuits which the chn thought may/may not work but having tested they found this not to be the case? Discuss misconceptions. Discuss what happened to the brightness of the bulbs when they added more bulbs or more voltage/batteries. Record ideas and explain that we will be looking at this in greater detail next lesson. Does the position of the switch make a difference? (no) Look at real example of a circuit diagram – why might it be useful? (in the same way a map navigates a car, a circuit diagram can provide a simpler version of the actual circuit and help aid repair).	Discussion drawing onto flipchart. Copy of 'will it work?' on the flipchart and paper copies for the children. Electrical equipment.

			Provide chn then with the opportunity to check their explanation by creating the circuits. This will also ensure they are interpreting the circuit diagrams and symbols correctly. Support- children make a circuit diagram which the TE will change so it no longer works. Can the children identify what needs repairing? Discuss with the chn what is happening. Move onto the identification of faults in circuit diagrams.		
Session	Learning Objectives	Introduction	Main activity	Application and review	Resources
4	**To compare and give reasons for variations in how componen ts function, including the brightness of bulbs, the loudness of buzzers** *I can associate the brightness of a lamp or the volume of a buzzer with the number*	Remind the children about their ideas from the end of last lesson about adding more bulbs and batteries. Add more bulbs into a series circuit. (This can be done using interactive resource on line if preferred). http://www.hyperstaffs.info/work/physics/child/main.html Encourage the children to observe what happens. *Adding more bulbs makes them dimmer because more resistance and therefore less electricity is allowed to flow. The bulbs should be of equal brightness because the same current flows through each bulb. The battery can only push a small amount of current around because of the resistance. If the bulbs are different brightness it is because the bulbs are different.* Record observations.	Explain that children are going to carry out an investigation to find out how the number & voltage of the cells in a simple circuit affect the brightness of bulbs, the loudness of buzzers or the speed of motors. Show children a range of cells with different voltages – check they can find the voltage marked on each cell. Then pass round bulbs of different voltages & show children where the voltage is marked. Explain that it is important that the voltage of the cells used in a simple circuit must not exceed the voltage of the bulbs used or they will 'burn out'. This means that the very thin filament wire in the bulb will be broken and therefore it will not be possible to make a complete circuit. If a battery is made of two or more cells the total voltage must be carefully checked. Ask children for suggestions of a question that they could answer, e.g. *Does adding more cells to the circuit make the bulb brighter? What effect does adding more cells have on the noise of the buzzer? How can the motor be made to turn more quickly? What happens if a cell with a larger voltage is added to a simple circuit?* Write suggestions on f/c. Discuss any problems that may occur. E.g. how will they know if the components are brighter/louder/faster?	Discuss with the class their findings. Use the website again to reinforce what the children discovered.	Variety of batteries and bulbs. Other components to make electrical circuits.

	and voltage of cells used in the circuit **Assessment : b**		In mixed ability groups, give chn time to decide which question they will try to answer. They then decide which simple circuit components they will need & how they are going to keep their test fair. Children should record their findings as they carry out the investigation. *With more batteries, we can make the bulbs brighter again by adding more voltage and therefore more push.*		
Session	Learning Objectives	Introduction	Main activity	Application and review	Resources
5	**LO: To compare and give reasons for variations in how components function, including the brightness of bulbs.** **Assessment: c, b**	Return to thinking about last lesson. Ask questions to draw out what children remember and understand. E.g. how would I make a buzzer louder? What would I need to be careful of? Reinforce with the children that overloading the circuit will mean that devices won't work properly. Take a look at the discussion page and what the chn are saying about the thickness and length of wires in a circuit. Which character do they think is right? Record chn's ideas on paper flipchart to be referred back to when writing their prediction. Chn to write their prediction.	Explain to the chn that we are going to do some investigating of our own. Pose the question e.g. Does the thickness of the wire effect the brightness of the bulb? Explain to the chn that we are going to investigate what happens when we alter the wires thickness in a circuit. Give the chn time to work in groups to generate ideas about how we could go about finding an answer to the question. Take feedback and use page 16 of the flipchart to plan together. Note: • Use a limited number of batteries so the bulbs do not burn out (remind chn about matching the components). • Make sure that chn have considered how we can scientifically measure the brightness of the bulb (e.g. how many layers of tissue paper is the bulb still visible through? Discuss SAFETY)	Allow chn to discuss their findings. Were their predictions correct? Were any of the results surprising or unexpected? Reinforce findings using website: http://www.hyperstaffs.info/science/work/child/circuits.swf Discuss reasons why. Return to the discussion page- were any of the characters right? (no). Ask the chn to correct their misconceptions with their concluding statements. *Note: Some chn think that thicker wires or more wires will allow more electricity to flow to the bulb. The brightness of the bulb depends on the resistance to*	Discussion page on flipchart. Wbs Electrical equipment for tests. Fuse wires of varying length. (Can be used because using very low voltage batteries).

			A preliminary test maybe needed at this point to see if this actually works! Also to try out different circuits to see which one has a suitable combination of batteries and bulbs to judge the brightness of the bulb. Discuss with the children how they will record their results. Chn carryout test	*the flow of electric current. Factor determining flow is the thickness (v thin) of the filament in a bulb.* *Using more wires or thicker wires will not make the bulb shine more brightly. Using very thin fuse wires may be possible to see that the flow is reduced and the bulb dimmer. Chn may think electricity will take longer to flow down a long wire. The length of the wire will not normally make a noticeable difference unless a VERY long wire or a reasonable length of thin wire).*	