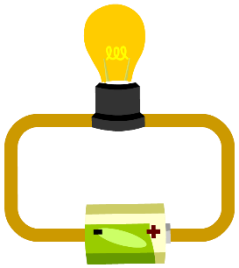
Progression in Electricity



National Curriculum statements in red are from other linked topics.

Early learning goal	• Children know about similarities and differences in relation to places, objects, materials and living things. They talk about the features of their own immediate environment and how environments might vary from one another. They make observations of animals and plants and explain why some things occur and talk about changes
Year 1	
Year 2	
Year 3	
Year 4	• identify common appliances that run on electricity • construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers • identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery • recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit • recognise some common conductors and insulators, and associate metals with being good conductors.
Year 5	
Year 6	• Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit. • 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. • Use recognised symbols when representing a simple circuit in a diagram.
KS3	• Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge. • Potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current. • Differences in resistance between conducting and insulating components (quantitative). • Static electricity

Year 4 – Electricity

National Curriculum

- identify common appliances that run on electricity
- onstruct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
- identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery
- recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit
- recognise some common conductors and insulators, and associate metals with being good conductors.

Pupils should construct simple series circuits, trying different components, for example, bulbs, buzzers and motors, and including switches, and use their circuits to create simple devices. Pupils should draw the circuit as a pictorial representation, not necessarily using conventional circuit symbols at this stage; these will be introduced in year 6

Pupils might work scientifically by: observing patterns, for example, that bulbs get brighter if more cells are added, that metals tend to be conductors of electricity, and that some materials can and some cannot be used to connect across a gap in a circuit.

Prior Learning

In Early Years:

- May have some understanding that objects need electricity to work.
- May understand that a switch will turn something on or off.

Key Ideas	Possible Activities
How do we use electricity in our homes?	• Brainstorm what pupils already know about electricity/components. • Discuss safe use. Poster. • Discuss where electricity comes from. Identify sources (e.g. power stations, wind/solar, battery, etc). Discuss how it gets to homes (use a solar powered fan/calculator as a stimulus). • Introduce concept of electric energy. • Sort cards of common appliances into those that use electricity (energy) and those that don't (or use other forms of energy). • Classify objects / pictures into those that use electricity and those that don't (could reclassify in any number of ways using information on cards) • Identify / recall components (including symbols) of circuits • Explore batteries, bulbs, wires, etc (describe similarities/differences).
Can you make a working series circuit?	• Demo: simple series circuit. Indentify components. Begin to develop 'energy transfer' model by emphasising energy flow. • Use drawings of circuits to predict whether they will work or not. Introduce circuit diagram. Emphasis battery orientation (+/- end) • Introduce 'energy flow/transfer' (current) around circuit • Construct series circuits (lamp) with a simple circuit board or components. Problem solve. • Introduce other components (e.g. buzzers, motors, etc). Draw circuit diagrams. Introduce more than one bulb. • Make a fan spin in both directions
How does a switch work?	• Demo: switch action on various devices (both mains / battery driven). Possibly introduce types of switch (press, slide, dry reed) • Construct / draw circuits to include a switch. Draw circuit diagram. Discuss how they work (break flow of energy). • Play 'Operation' or 'steady-hand' game • Make a switch using a paper clip or pins. • Make a 'steady-hand' game • Play with remote control cars, 'operation' game, etc.
What are electrical conductors & insulators?	• Introduce action of conductors & insulations using energy transfer model (energy flow). • Use a two-core sheathed wire to stimulate explanations using K&U and the model • Research/explore examples of electrical insulators / conductors • Which materials allow electrical energy to flow? Use ammeter/bulb; use a box of materials to test which completes the circuit. Label as conductors or insulators. Predict. • Make conducting / insulating play dough. Build squishy circuits (prevent short circuits)

Vocabulary

Electricity, electrical appliance/device, mains, plug, electrical circuit, complete circuit, component, cell, battery, positive, negative, connect/connections, loose connection, short circuit, crocodile clip, bulb, switch, buzzer, motor, conductor, insulator, metal, non-metal, symbol

In Year 6:

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- 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.
- Use recognised symbols when representing a simple circuit in a diagram.

Year 6 – Electricity

National Curriculum Objectives:

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- 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.
- Use recognised symbols when representing a simple circuit in a diagram.

Building on their work in year 4, pupils should construct simple series circuits, to help them to answer questions about what happens when they try different components, for example, switches, bulbs, buzzers and motors. They should learn how to represent a simple circuit in a diagram using recognised symbols.
Note: Pupils are expected to learn only about series circuits, not parallel circuits.
Pupils should be taught to take the necessary precautions for working safely with electricity.
Pupils might work scientifically by: systematically identifying the effect of changing one component at a time in a circuit; designing and making a set of traffic lights, a burglar alarm or some other useful circuit

Prior Learning

In Year 4:

- identify common appliances that run on electricity
- onstruct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
- identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery
- recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit
- recognise some common conductors and insulators, and associate metals with being good conductors.

Key Ideas	Possible Activities
Can you make a working series circuit?	• Brainstorm prior knowledge including components and symbols; electricity is energy. Energy transfer model. • Match components to symbols. Quiz. Emphasise direction of cells in the battery (+/- ends) • Demo: bulb (heat light), buzzer (sound, movement). Train track to model energy transfer. Link to voltage (& current) • Follow a diagram to set up a simple series circuit. Emphasise closed circuit and avoid short circuits. Include different types of switches. • Problem solve incorrectly set up circuits. Explain using the energy transfer model (review from yr4).
How can we change the amount of energy in a circuit?	• Concept of cell / battery (store of energy). Symbol showing terminals. Battery containing more cells; more energy. Draw energy flow onto circuit diagrams. • Concept of voltage (push/transfer of electrical energy to the circuit). Cell = 1.5 V. Calculate cells needed to provide different voltage. Predict voltage around the circuit. Test. • Link to components that have required voltage. Link to different types of battery that have different Voltage outputs. • Fair test – How can we change the brightness / loudness of bulb / buzzer? (number of cells/bulbs). • Measure voltage using a Voltmeter (set in parallel) on a series circuit for different numbers of batteries in a cell. Link energy transfer in (battery) and energy transfer out (e.g. Bulb). • Fair test: Home-made batteries (tomato/lemon juice, potato). Change number in series. Measure voltage/brightness with LED bulb.
What is electrical resistance?	• Yr6/6+ - Link concept to 'resisting' energy flow (electrical safety; prevent overheating by ensuring wire is not too short/narrow). Explain using energy transfer. • Resistance can be calculated using V=IR. Could just use brightness of bulb (not voltage/current) to differentiate. • Fair test: What happens to the current/voltage as we increase the length of a wire/graphite rod? Place wire over a meter ruler. Take 5 readings at different lengths (not less than 20 cm) • Fair test: What happens to the current/voltage as we increase the thickness of a wire? Use wire wool to change thickness of wire (place within a straw)
What happens to the energy as it flows around a circuit?	• Explain using energy transfer model (energy lost, drop in Voltage after bulb). Link to resistance (more bulbs; greater resistance to flow; less Amps). Use central heating system or train model to explain relationship between current and voltage. Possibly include resistance for 6+ (V=IR) • Fair test – What happens to the brightness when we increase the number of bulbs? (Series only). Explore changing number of bulbs/cells. • Measure Voltage (Voltmeter) & possibly current (Ammeter) at different points. Graph.
Can you make …?	• Research and plan to make interesting circuits, perhaps on a theme (e.g. disco, fairground, home security, etc) • Test effectiveness of circuits to make improvements • E.g. dance floor, fairground games, intruder alarm • Construct game – bulb lights up / buzzer for right answer

Vocabulary

Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage

NB Children do not need to understand what voltage is but will use volts and voltage to describe different batteries. The words cells and batteries are now used interchangeably

In KS3:

- Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge.
- Potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current.
- Differences in resistance between conducting and insulating components (quantitative).
- Static electricity.