

SWITCHED ON

INTRODUCTION

All children will have experience of electricity in their everyday lives and many of them will have built and investigated simple circuits to make things work at home or in the Foundation Stage. So although this module is the first time that electricity will be taught in KS1 and 2 children's prior knowledge and understanding should be elicited and built on. In this module they will identify electrical appliances, distinguishing between those which are powered by mains and battery (including those with integral rechargeable batteries) and recognising that electricity can be used to produce light, sound, heat and movement. They will explore the production of light, sound and movement by making simple series circuits with cells, wires, bulbs, buzzers and motors, learning the names of the components. They will work mostly with single components. In Year 6 they will investigate the effect of adding and changing components. Through detailed observation and role play they will be able to describe the flow of electricity round a circuit and give reasons why some circuits do not work. They will then learn to control their circuits with switches. They will test materials, classify them as electrical conductors or insulators and recognise that metals are good electrical conductors and plastics are good electrical insulators. They will apply this knowledge when making their own switches and electrical quiz boards. Throughout this module they will learn the safe use of electrical components and the dangers of mains electricity.

When working scientifically children will make observations and describe how circuits work using scientific language. They will also communicate using labelled and annotated drawings. Drawings are an important way for children to demonstrate their developing understanding. Circuit diagrams with symbols will be introduced in Year 6. They will plan and carry out a classifying enquiry, recording findings using tables, Venn and Carroll diagrams and will recognise that generalisations cannot be made from small amounts of evidence.

Key vocabulary:

electricity, electrical, mains, plugged in, battery, power, rechargeable, solar, wind up, sound, light, heat, movement, cell, wire, bulb, bulb holder, buzzer, motor, component, circuit, complete circuit, short circuit, flow, break, make, metal, connect, disconnect, terminal, positive, negative, switch, press switch, toggle switch, tilt switch, pendulum switch, property, electrical conductor, electrical insulator, electron, filament, sets, Venn diagram, Carroll diagram, table, conclusion, evidence, annotate

Health and safety:

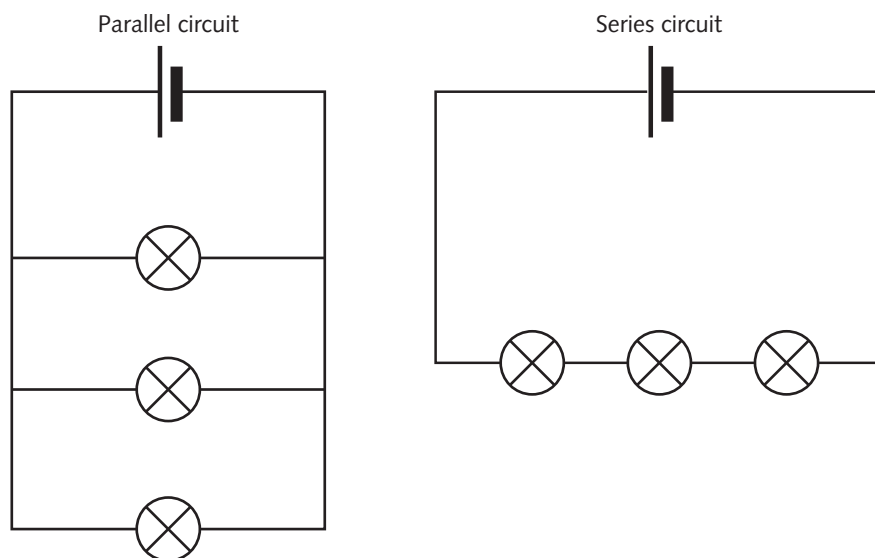
Zinc-carbon and zinc-chloride batteries are the most suitable for this type of activity. Alkaline and rechargeable batteries may become hot enough to cause burns if there is a short circuit. Follow guidance in Be Safe! section 14.

FACT FILE:

A **cell** is the correct term for what is commonly called a **battery**. A cell is a single unit of electrical supply providing a voltage of 1.5V. Technically a battery is a collection of cells and will have a voltage which is a multiple of 1.5. The **voltage** of a battery is a measure of how much **energy** (or 'push') it can provide. It is important to match the voltage on other components to the voltage of the battery. A 6V bulb or motor will not work if a single 1.5V cell is used. A 1.5V bulb is likely to blow if connected in a circuit with several cells. Mains electricity is dangerous because it has a high voltage.

Electricity (or electrical current) is a **flow of electrons** (negatively charged particles) which transfers energy. It requires an **energy source**, such as the **chemical reaction** that takes place in the cell, and a **complete circuit**. Children need to know that a complete circuit is required for electricity to flow and that the cell is the power source for the circuit, which creates the flow of electricity. The flow of electricity (which carries energy) through a bulb, motor or buzzer is what makes it work. It is not a curriculum requirement for them to know what electrons are or that it is electrons which flow, but introducing this idea can help to counter common misconceptions. It is also not necessary for children to understand energy transfer at this stage.

Electrons are present throughout the circuit so the flow in all parts of the circuit is instantaneous when it is connected. A cell has a **positive terminal** and a **negative terminal**. Although current is sometimes shown in circuit diagrams as flowing from positive to negative, this is a convention that pre-dates scientific understanding of what electricity is. Electrons are negative so electricity actually flows from the negative terminal of the cell to the positive one. Because electricity is a flow through all parts of the circuit at the same time a complete circuit is always needed.



A series circuit is a single loop. Parallel circuits have multiple loops connected to the same cell. The series circuit is the only type which children need to know in Key Stage 2, so the word 'series' does not need to be introduced.

A **short circuit** occurs when electricity flows from the negative to the positive terminal of the cell without passing through a component which has resistance to the flow of electricity and will use some of the energy. Electricity will always take the 'easy' route, the path of least resistance. A short circuit can cause overheating and will drain the battery very quickly so should be avoided.

A **switch** is a means of controlling the flow of electricity in the circuit. When the switch is open the circuit is broken: there is a gap which prevents electricity from flowing. When the switch is closed the circuit is made and electricity flows. There are many different types of switch; some of the most common are shown in the resource sheets for Lessons 5 and 8.

Materials with electrons which can move easily have very low resistance to the flow of electricity and are **electrical conductors**. Metals are good electrical conductors. Materials which do not allow electricity to flow through them are known as **electrical insulators**. Most non-metals are electrical insulators although graphite, a form of carbon, is an exception. **Electrical conductivity** is a continuum (not a simple yes or no) with some materials conducting better than others.

The flow of electricity can be modelled in many different ways such as the flow of water in pipes and the wheels, pedals and chain of a bicycle. Like all models and analogies, they all have their merits, but none of them is a complete analogy so in this module a simple role play is used. The role play can be extended to show energy transfer, but this would be more appropriate for Year 6 or KS3.

Common misconceptions

- Mains electricity and batteries are entirely different things – battery powered devices are not electrical.
- Electricity goes to rather than through a component so only one wire is needed. In this model electricity is seen as a fuel used by the component rather than a flow through it. This misunderstanding can be seen in the way some children try to connect circuits and in their drawings.
- Mains electricity only requires one wire (because the different wires within the single cable are not visible).
- Electricity is something which is made by the battery and has to travel to the component rather than flowing in all parts of the circuit at once.
- A switch will only control a component if it is 'before' the component in the circuit.
- Water conducts electricity. Although it is a rule of electrical safety not to mix electricity and water, pure water does not conduct; it is the impurities in tap water which allow it to conduct electricity.