DANGER! LOW VOLTAGE

INTRODUCTION

In this module children develop their understanding of electrical circuits and build on the work in the Year 4 module. They construct circuits with an increasing number of components and contrast the effects this has on the function of the components. They role play the fl ow of electricity through a basic circuit and one that includes fuse wire, to model the effect that this has on other components.

The children learn to use the recognised electrical symbols to record circuits, particularly as the circuits become more complex. They research how electricity is generated both traditionally using coal and gas, and by renewable resources, and investigate how electricity is transmitted across the country, and what sort of electricity generating plant they might site in their locality.

National Curriculum:

Use recognised symbols when representing a simple circuit in a diagram

Compare the functions of different components, giving reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off positions of switches, and use recognised symbols when representing a simple circuit in a diagram

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, and use recognised symbols when representing a simple circuit in a diagram

There are no direct links to the three statements in the science national curriculum, as these two lessons involve carrying out research and constructing reports about electricity in everyday use

Working Scientifically:

Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

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

Reporting and presenting findings from enquiries in oral and written forms

Identifying scientific evidence that has been used to support or refute ideas or arguments

Scientific Enquiry:

Carrying out simple comparative and fair tests

Finding things out using secondary sources of information

Key vocabulary:

cell, battery, lamp, wire, buzzer, motor, circuit, current, filament, electrical insulator, electrical conductor, mains electricity, terminal, switch, toggle switch, push switch, slide switch, tilt switch, trembler switch, pressure switch, reed switch, series circuit, resistance, resistor, current, circuit diagram, recognised symbols, generate, generator, coal, gas, oil, fossil fuels, nuclear, biomassfired power stations, wind turbine, wave hub, tidal flow, hydro-electric, grid, pylon, transmission, transformer, solar panels

FACT FILE:

See also the module introduction for Year 4, Module 3, Switched On.

Electricity is a flow of electrons and this flow produces an electric current. A single battery is called a cell. Batteries are formed when a number of cells are grouped together. Once all the chemicals in a cell have reacted together, then no more extra electrons can be produced and the cell is ‘dead’. A chemical reaction in a cell results in extra electrons at the negative terminal and a shortage at the positive terminal. As electrons are negatively charged they are attracted to the positive terminal when the two terminals of a cell are connected in some way. The current in all parts of a circuit is instantaneous and equal. Electrons keep fl owing through the circuit and they are not used up in the creating of light, movement or heat.

The contents of a cell vary depending on the type of cell.

Cells, switches, lamps, buzzers, motors, etc., are called components of circuits. They have two connection points called terminals. Both terminals must be connected to a power source's terminals in a loop for the electrons to flow and for the circuit to be complete. It is possible to construct a circuit and light a lamp using only one piece of wire, a cell and a lamp.

There are four more ways to complete the circuit by reversing the wire in the above diagrams.

Voltage is the driving force that causes current to flow around a circuit – 'the push'. It is the difference in potential energy between the positive and the negative terminals. As the voltage increases so does the work the current can do. For example, the higher the voltage in a circuit the brighter a lamp shines and the faster a motor turns. Matching the voltage of cells and components in circuits is essential to avoid 'blown' lamps and 'burned out' motors. Voltage is measured in volts.

Resistance is the measure of the difficulty electrons have in fl owing through a material. It is much easier for the electrons to flow through a thick wire than through a thin wire. The resistance is much higher in a thin wire. Lamp filaments are very thin wire and have a high resistance. This converts the electrical energy into heat energy and results in the filament glowing white hot, therefore giving light as well as heat. Resistance is measured in ohms.

These symbols are the recognised scientific conventions for representing circuits:

Cell		Three-way switch	
Battery (2 or more cells)		Push switch	
Lamp		Resistor	
Buzzer		Variable resistor	
Motor	M	Wires	
Open switch		Where wires join	
Closed switch		Where wires cross	
Two-way switch			

The scientific convention for circuit diagrams always shows wires as straight lines with right angle turns.

Mains electricity is generated at power stations at very high voltages, although power station outputs are usually measured in megawatts (1 MW = 1 million watts). Watts are the power in a circuit. For example, a 100 watt lamp will be much brighter than a 60 watt lamp. Electricity is transmitted to houses, offices and factories through a series of large cables either suspended from pylons or laid underground. This system is called the national grid. As the electricity gets closer to homes it is systematically stepped down by sub-stations containing transformers that gradually reduce the voltage from the hundreds of thousands of volts generated in power stations to the 230 V used in the home. Mains electricity is a big circuit so when a kettle is plugged in at home, the circuit is complete from the house to the power station and back again. Power stations are like a large cell. Electricity is generated by:

- burning fossil fuels such as coal, gas and oil
- biomass energy – burning wood chip and domestic and commercial waste
- nuclear reaction
- movement of water – tidal flow, wave motion, falling water
- solar energy
- wind energy