

Key concept (age 11-14)

PEM1.1: Making circuits

What's the big idea?

The familiar everyday world we live in is largely a consequence of the properties and behaviour of electric charge. Matter is held together by electromagnetic forces, and these determine chemical changes. Electricity and magnetism initially seem distinct phenomena but are later found to be closely interrelated. Understanding electricity and magnetism helps us to develop our technology and find applications that can transform our everyday lives.

A key concept of this big idea is a thorough understanding of what a complete circuit is. Developing students' competencies in building, testing and representing electric circuits will allow students to more easily construct and interpret the circuits they will use to develop their thinking on the more challenging aspects of electricity later on. Nothing else behaves quite like electricity and we need to make it as easy as possible for students to develop a good understanding of ideas like current, voltage and resistance.

What the science story?

A simple electric circuit consists of a single device connected by wires to the two terminals of a battery (or power supply), perhaps with a switch somewhere in the loop. When it is switched on, there is an electric current everywhere in the circuit instantly.

Standard symbols are widely used to represent electric circuits. These show the connections in the circuit, but not its physical shape or appearance. Circuits are normally shown as rectangular, with 90° corners and straight connecting wires.

Guidance notes

Many students move into secondary education, and change schools, at age 11 and, if this is the case, it is likely that the electric circuit equipment that you will be using is unfamiliar to them. This can strongly influence the ease with which they will recall their earlier learning and, before progressing, it is most probably necessary to spend some time building circuits and reminding them of what they have already learnt.

Concept organiser

Use **diagnostic items** to provide evidence of what students know and can do, and to diagnose the presence of misconceptions.

Respond to misconceptions using **response items** before moving on to the next learning outcome.

Learning objective 1	Know and use the conventional circuit symbols and circuit diagram conventions.				
Observable learning outcomes	➔				
	Build simple circuits from pictures or demonstrations.	Identify components from their circuit symbols, and draw the circuit symbol for common components.	Identify circuit diagrams that represent a series circuit by tracing round the circuit.	Interpret circuit diagrams to build series circuits.	Use circuit symbols and circuit diagram conventions to draw clear and precise circuit diagrams of electrical circuits.
	P	P	P	P	P
Diagnostic items	Circuit from a picture	Circuit symbols	Circuit diagrams (1)	Circuit from a diagram	Circuit diagrams (2)
Response items	Building circuits (1)			Building circuits (2)	Drawing circuits

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

Learning objective 2	Understand the idea of an electric circuit (a closed conducting loop containing a battery).				
Observable learning outcomes	➔				
Observable learning outcomes	Predict if a circuit will work, by tracing the circuit to find out if it is complete. P	Describe how a simple circuit can be used to identify conductors and insulators. P	Describe how a simple circuit can be used to test for faulty components, and trace the circuit through components to identify breaks in the conducting loop.	Describe how a switch in a circuit affects the flow of electricity everywhere: when it is closed (on) electric current flows everywhere; when it is opened (off) current stops everywhere.	Explain how to fault test, and fix, a more complicated series circuit without taking it apart.
Diagnostic items	Will it work?		Bulb in a circuit	Switches in the circuit	Circuit repair
Response items			Light a bulb	Broken circuit	Fixing circuits
Response items			Testing components		

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning