

# Describing electric circuits

We are learning how to:

- Describe and draw circuit diagrams.
- Explain what is meant by current.
- Explain how materials allow current to flow.

A light bulb in an electric circuit lights up instantaneously. Even if the circuit were the size of a football pitch, there would be no time delay for the light to come on. What is actually going on in the circuit for energy to be transferred so quickly?

## Components in electric circuits

An electric circuit is a loop of wire with its ends connected to an energy source, such as a battery or cell. Strictly, a 'battery' is two or more cells together.

When a circuit is complete, energy is transferred from the battery to the wires by an electric current. Devices such as light bulbs, motors and buzzers are **components** that can make use of the energy transferred from the battery.

The components in the circuit need an electric current to pass through them. If there are any gaps in the circuit, the current will not flow and energy cannot be transferred. A material that allows current to pass through it is called an electrical **conductor**. These have electrons that are free to move within the conductor. An electrical **insulator** does not have any free electrons and cannot allow a current to pass.

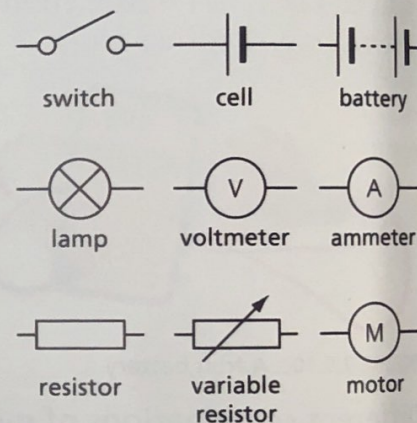


FIGURE 2.6.11a: Circuit symbols for common components

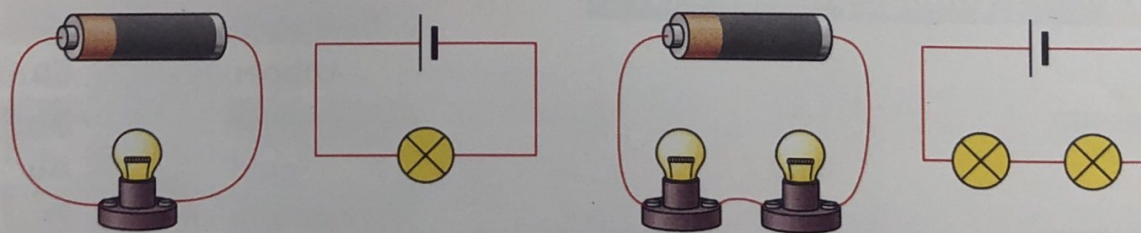


FIGURE 2.6.11b: How circuit symbols are used to represent components in a circuit diagram

1. If pencil lead is placed in a circuit with a light bulb, the bulb lights up. What conclusion can you draw about this material?
2. Draw a circuit diagram for a circuit with one cell and three bulbs.
3. Why is it important to represent components with symbols?

## Using models to explain current

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Current is the rate of flow of charge (electrons) in the circuit, and is given the symbol  $I$ . It is measured by an **ammeter** in **amperes** (symbol A), after the French scientist Andre-Marie Ampere.

Models and analogies are often used to explain complex phenomena like current. One analogy is to compare electric current to water flowing in a stream. The charges are the water particles, and the current is the flowing stream.



Another analogy used to represent current is that of a convoy of coal trucks. The trucks represent the charged particles, the movement of the trucks represents the current, and the coal they carry represents the energy they transfer.



FIGURE 2.6.11c: In the analogies pictured in the photos, what represents the charge and what represents the current?

- Using first the water analogy and then the coal-truck analogy, draw diagrams to show the difference between a low current and a high current.
- Which analogy is better at explaining that current transfers energy to different components? Explain your answer.

## Scientific explanation of current

When the battery is connected, the electrons in all parts of the wires within the circuit move at the same time, in the same direction and at the same rate. This movement constitutes the current. In this way, no matter where the components are in the circuit, they will all conduct at the same time – there is no delay because all the electrons in the circuit move simultaneously.

Current is not used up in the circuit. It has the same value before and after each component in the circuit – indeed, it is the same everywhere in the circuit.

- Explain the strengths and limitations of the two analogies above, in light of the scientific explanation for current.
- Explain why current is not used up in a circuit.

### Did you know...?

A current of 1 amp means there are 6 250 000 000 000 000 000 electrons flowing past a point every second!

### Key vocabulary

component  
conductor  
insulator  
ammeter  
ampere