

Building and drawing simple circuits

Grade 6 science (Year 7 · Class 6) · Lesson

Quick answer: A simple electric circuit is a complete, closed loop of conductors that joins a cell to components such as a bulb and a switch. Current flows only when the loop has no gaps. Conductors, like metals, let current through; insulators, like plastic and rubber, do not. Circuit diagrams use standard symbols.

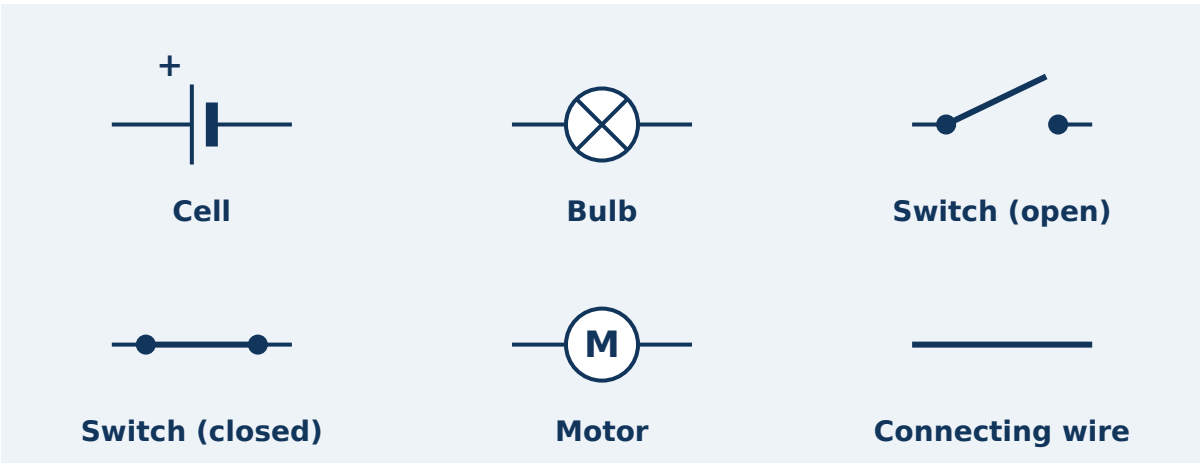
Level: Grade 6 science (Year 7 · Class 6) · **Curriculum:** MS-PS2-3

What is an electric circuit?

An electric circuit is a complete path that lets electric current flow from a source of energy, through components, and back to the source. The simplest circuit has a cell, a bulb, a switch and connecting wires. The cell pushes the current round the loop, the bulb gives out light, the switch opens or closes the path and the wires carry the current. A battery is two or more cells joined together, but a single torch cell is often called a battery in everyday speech.

Definition
An **electric circuit** is a complete loop of conducting material that connects a source of electrical energy, such as a cell, to one or more components so that an electric current can flow.

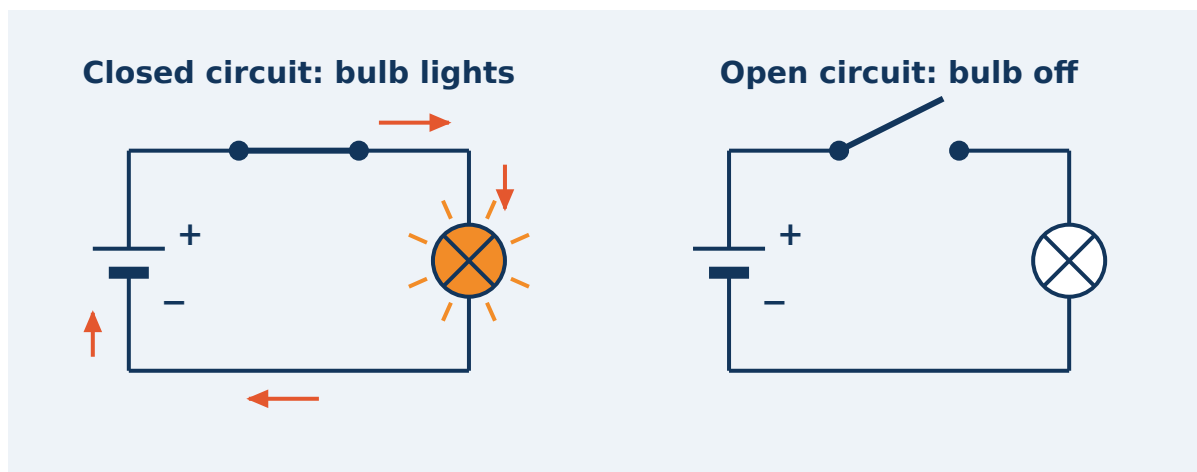
Component	What it does
Cell	Provides the energy that pushes the current
Bulb	Changes electrical energy into light (and some thermal energy)
Switch	Opens or closes the circuit to turn it off or on
Motor	Changes electrical energy into movement
Wire	Carries the current between components



Standard circuit symbols. The longer line of the cell is the positive terminal.

What is the difference between a closed and an open circuit?

A circuit is **closed** when there is an unbroken conducting path all the way round, from one terminal of the cell to the other. A circuit is **open** when there is a gap anywhere in the loop, such as an open switch, a cut wire or a loose connection. Current flows only in a closed circuit. By convention we draw the current leaving the positive terminal of the cell, going round the circuit and returning to the negative terminal.



In the closed circuit the red arrows show the conventional current; in the open circuit there is a gap, so nothing flows.

Key rule

Current flows only when there is a source of energy and a complete, closed loop of conductors. A gap anywhere in the loop stops the current everywhere in that loop.

How do you draw a circuit diagram?

A circuit diagram shows how components are connected using standard symbols. Draw it with a pencil and ruler, use straight wires that meet at corners, leave no gaps and keep symbols clear of the corners. The diagram does not need to look like the real objects, only to show the connections correctly.

Worked example 1

Wanjiru builds a circuit with a cell, a bulb and a closed switch, but the bulb stays off. One wire from the bulb is hanging loose. Explain the fault and the fix.

Method: follow the loop from the positive terminal of the cell, through the switch and the bulb, and back towards the negative terminal. At the loose wire the path stops.

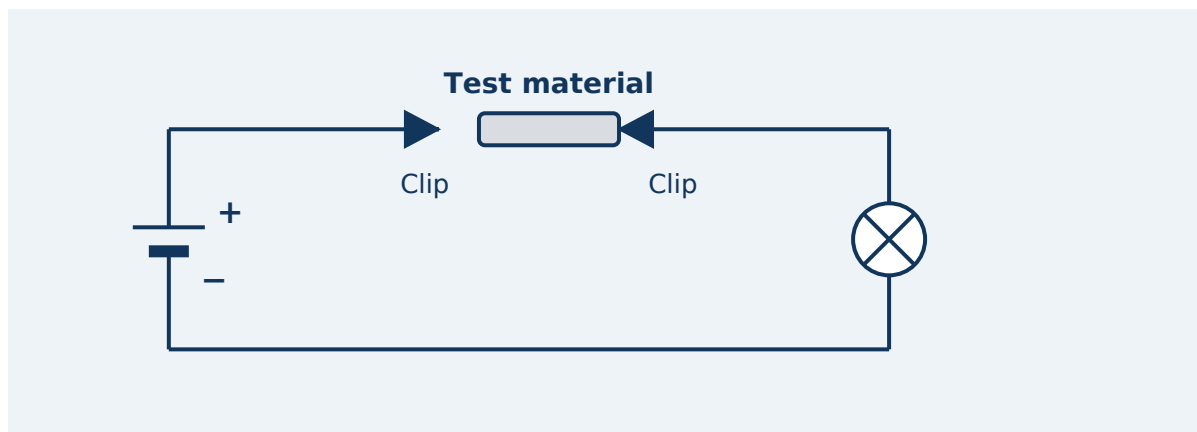
Answer: **the circuit is open because of the gap at the loose wire.** Connect that wire to the negative terminal of the cell to make a closed loop, and the bulb will light.

Which materials let electric current flow?

Materials are sorted by how well they let current flow. We can test them by placing each one in the gap of a tester circuit and watching the bulb.

Definition

A **conductor** is a material that lets electric current flow through it easily, such as most metals. An **insulator** is a material that does not let current flow easily, such as plastic, rubber, glass and dry wood.



If the bulb lights when the material joins the clips, the material is a conductor.

Conductors	Insulators
Copper, aluminium, iron, steel	Plastic, rubber
Graphite (pencil lead)	Glass, dry wood
Salt water	Cotton, air

Worked example 2

Mei tests five objects in a tester circuit. Iron nail: bulb bright. Plastic ruler: bulb off. Pencil lead: bulb dim. Wooden spoon: bulb off. Aluminium foil: bulb bright. Classify each object.

The bulb lights when the material conducts. Answer: **conductors: iron nail, pencil lead, aluminium foil; insulators: plastic ruler, wooden spoon.** The dim bulb for the pencil lead shows that graphite conducts, but not as well as the metals.

Common mistake

Many students think the bulb "uses up" the current, so there is less current after it. The current is the same all the way round a simple loop; it is the energy from the cell that the bulb transforms. Never test materials with a mains socket: mains electricity can kill.

Lina's tip

Trace your circuit with a finger from the positive end of the cell all the way round to the negative end. If you can do it without crossing a gap or lifting your finger, the circuit is closed.

Key points to remember

- A circuit needs a source (cell) and a complete loop
- Open circuit: a gap stops the current everywhere
- Conductors (metals, graphite) let current flow; insulators do not
- Standard symbols: cell, bulb, switch, motor, wire
- Use cells only; never test with mains electricity

Building and drawing simple circuits: frequently asked questions

What does a bulb need to light up?

A bulb needs a source of energy such as a cell and a complete closed loop of conductors. If there is a gap anywhere in the circuit, no current flows and the bulb stays off.

What is the difference between an open and a closed circuit?

In a closed circuit the conducting path is complete, so current flows. In an open circuit there is a gap, for example an open switch or a broken wire, so current cannot flow.

What is a conductor?

A conductor is a material that lets electric current flow easily. Most metals, such as copper, aluminium and iron, are good conductors, and graphite also conducts.

Why do we use plastic around electric wires?

Plastic is an insulator, so it keeps the current inside the metal wire. It protects people from electric shocks and stops neighbouring wires from touching.

Why must we never experiment with mains electricity?

Mains electricity is much stronger than the electricity from a cell and can cause serious injury or death. In school experiments we use small cells, which are safe.