

Series and parallel circuit patterns

Grade 7 science (Year 8 · Class 7) · Lesson

Quick answer: In a series circuit the components are connected in one single loop, so there is only one path for the current and the bulbs share the supply. In a parallel circuit they sit on separate branches, so each bulb works on its own and gets the full voltage of the cells.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS2-3

What is the difference between series and parallel circuits?

A circuit is a complete loop that lets charge flow. When you have more than one component, such as two bulbs, there are two basic ways to join them.

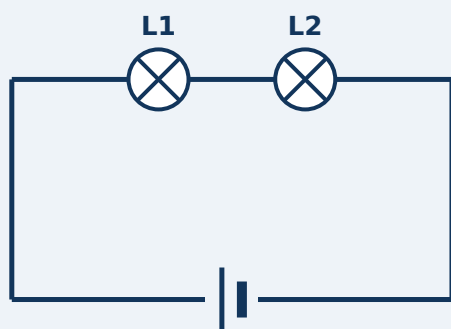
Definition

In a series circuit the components are connected one after another in a single loop, so there is only one path for the current.

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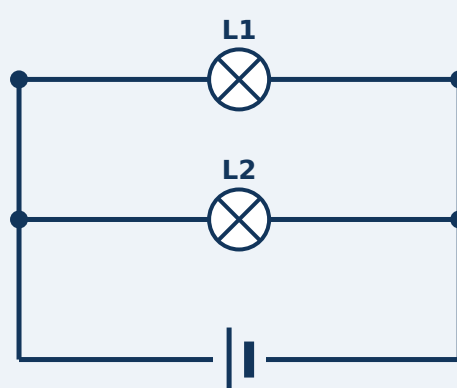
In a parallel circuit the components are connected on separate branches, so there is more than one path for the current.

Series: one path



Remove one bulb and the loop is broken

Parallel: two paths



Each bulb has its own branch

In the series circuit the current has one route. In the parallel circuit it can take either branch.

How do bulbs behave in series and in parallel?

The pattern is easy to see in a circuit with identical bulbs. In series, the bulbs depend on each other. In parallel, each bulb works on its own branch.

Feature	Series circuit	Parallel circuit
Paths for the current	One	Two or more
One bulb blows or is removed	All bulbs go out	The other bulbs stay on
Adding more bulbs	Every bulb gets dimmer	Every bulb stays as bright
A switch	Anywhere in the loop turns everything off	In a branch, it turns off only that branch
Typical use	Old fairy lights, safety interlocks	House lights, sockets, car headlamps

Worked example 1

Emma in Leeds has a string of four old fairy lights wired in series. One bulb is loose in its holder. Predict what the other three bulbs do and explain why.

The loop is broken at the loose bulb, so the current has no path. **All four bulbs go out.**

Worked example 2

Femi in Lagos has three ceiling lamps wired in parallel. One lamp blows. Predict what the other two do and explain why.

Each lamp has its own branch connected straight to the supply. **The other two stay on at the same brightness.**

Common mistake

Many students think current is "used up" by the first bulb so the later ones are dimmer. In reality, bulbs in series are dimmer because they share the energy from the supply, not because the first bulb takes the current.

How do cells join together?

Cells can be joined in series or in parallel. Joined in series, with the + end of one touching the – end of the next, their voltages add. Joined in parallel, the voltage is the same as one cell, but the cells share the work, so the supply lasts longer.

Formula

$$V_{\text{total}} = V_1 + V_2 + V_3 + \dots$$

V_{total} is the supply voltage of cells in series (V). V_1 , V_2 , V_3 are the voltages of the individual cells (V).

Worked example 3

Wanjiru in Nairobi has a torch that needs 6.0 V. Each of her cells gives 1.5 V. Calculate how many cells she must join in series.

Number of cells = $6.0 \text{ V} \div 1.5 \text{ V} = 4 \text{ cells}$.

Cells in series



$$1.5 \text{ V} + 1.5 \text{ V} + 1.5 \text{ V} = 4.5 \text{ V}$$

Push adds up

Cells in parallel



Voltage stays 1.5 V

Supply lasts longer

Cells in series add their voltages. Cells in parallel keep the voltage of one cell.

What is a short circuit and why is it dangerous?

Definition

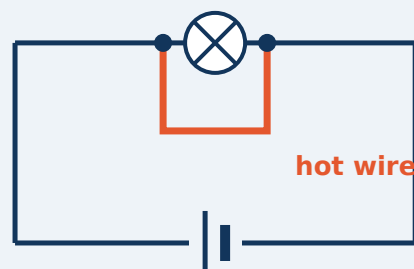
A short circuit is an easy path, often a wire or damaged insulation, that lets current bypass the components. A very large current can flow, and the wires and cells get hot.

Normal circuit



Bulb lights: current passes through it

Short circuit



Bulb off: current takes the wire

A wire across the bulb gives the current an easier path. The bulb goes out and the wire can overheat.

- A **fuse** contains a thin wire that melts if the current gets too large. It must be in series with the appliance.
- A **circuit breaker** switches off automatically and can be reset.
- Never join a wire straight across a battery or the mains, and never use cables with damaged insulation.
- Keep water away from electrical sockets and plugs.

Lina's tip

To decide whether bulbs are in series or parallel, put your finger on the + end of the cell and follow the wire. If you reach a point where the path splits, the circuit has parallel

branches.

Key points to remember

- Series: one path; if one bulb fails, all go out.
- Parallel: separate branches; the other bulbs stay lit.
- Cells in series: voltages add ($4 \times 1.5 \text{ V} = 6.0 \text{ V}$).
- A short circuit is an easy path that bypasses the components.
- A fuse is placed in series and melts if the current is too large.

Series and parallel circuit patterns: frequently asked questions

What is the main difference between series and parallel circuits?

In a series circuit there is one path for the current, so the components share the supply and depend on each other. In a parallel circuit there are separate branches, so each branch works independently.

Why are houses wired in parallel?

In parallel each lamp or socket gets the full supply voltage and can be switched on or off without affecting the others. If one lamp fails, the rest keep working.

What happens if one bulb blows in a series circuit?

The loop is broken, so the current stops and all of the bulbs go out. In a parallel circuit the other bulbs stay lit.

What is a short circuit?

A short circuit is an easy path that bypasses the components, so a very large current flows. It can overheat wires and cells and cause a fire, which is why fuses and circuit breakers are used.

Do bulbs stay bright when added in parallel?

Yes. Each bulb has its own connection to the supply, so each gets the full voltage of the cells. The cells run down faster, though, because they supply more current.