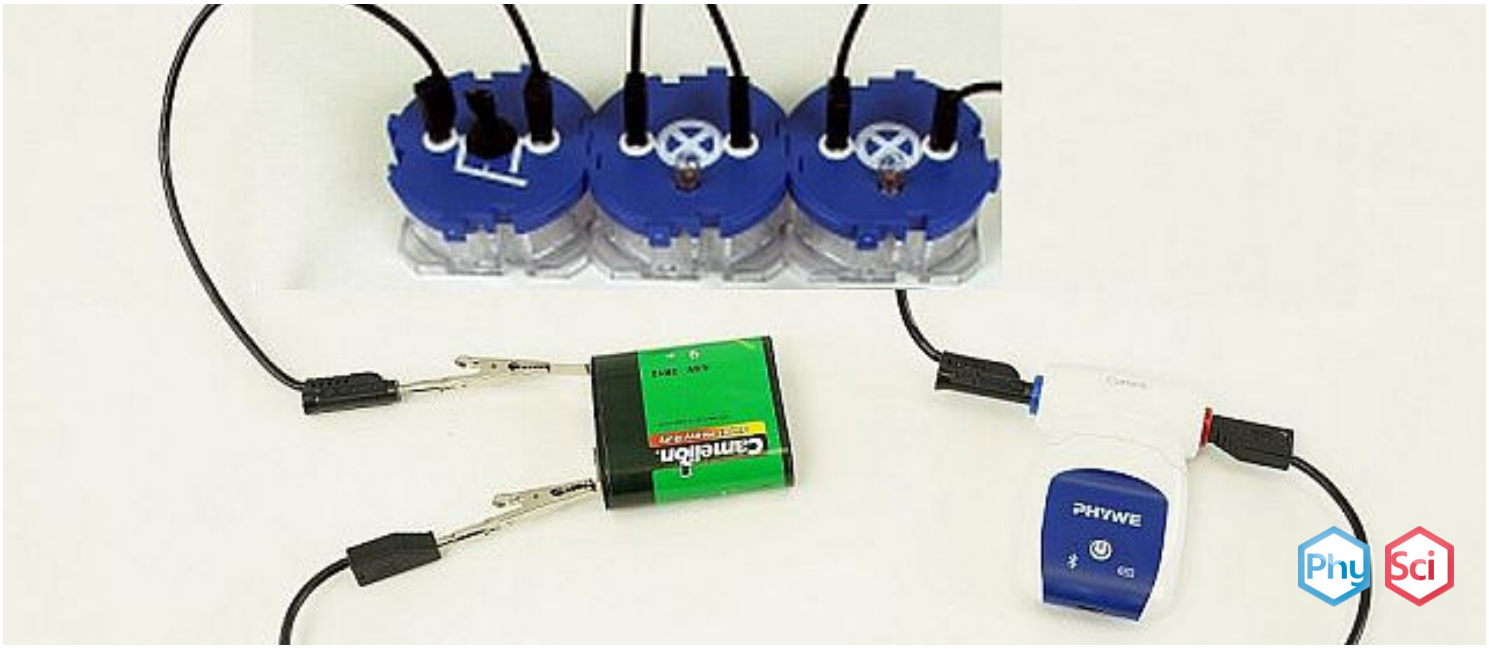
Series and parallel connection of light bulbs with Cobra SMARTsense



The students investigate the behaviour of two light bulbs in an electric circuit in series and parallel connection. In doing so, they find that in the series circuit all consumers must be intact, whereas in the parallel circuit, if one consumer fails, the others are not affected.

Nature & technology | Devices & machines in everyday use

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/6055c7b90454b70003729ff1

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Teacher information

Application

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Experimental set-up

In this experiment, the students investigate the behaviour of two light bulbs in an electric circuit in series and in parallel connection.

They find that in series connection all consumers must be intact, while in parallel connection if one consumer fails the others are not affected.

From this they conclude that the design of a circuit has a significant influence on the behaviour of the consumers and that both circuits have different advantages and disadvantages depending on the application.

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Other teacher information (1/2)

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Prior knowledge

The students are familiar with the principle of the electric circuit and can draw and implement circuit diagrams. The students know the current as a physical quantity and can measure it on their own in the circuit using the SMARTsense measuring device.

Scientific principle

The students autonomously learn the behaviour of the two circuits in the event of the failure of a consumer. If necessary, the current measurements, which should show that a much higher current flows in the parallel circuit, can be omitted. This allows the brighter glow of the light bulbs to be explained clearly.

Notice: However, Ohm's law, which would fully describe the observed phenomenon, will not be discussed here.

Other teacher information (2/2)

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Learning objective

The students learn the basic difference between series and parallel circuit. They understand why, in contrast to the series circuit, if one consumer fails the other still lights up in the parallel circuit.

Tasks

- The students build a series and then a parallel circuit with two light bulbs
- They observe the brightness of the light bulbs and measure the flowing current each
- They remove one of the bulbs from the circuit and observe what happens

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Safety instructions

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- The use of the battery means that there is no electrical hazard from the set-up. Nevertheless, the use of the on/off switch makes sense, as it is not assumed that the students can assess the danger.
- Make sure that the students always break the circuit when making changes to the experimental set-up.
- The general instructions for safe experimentation in science lessons apply to this experiment.

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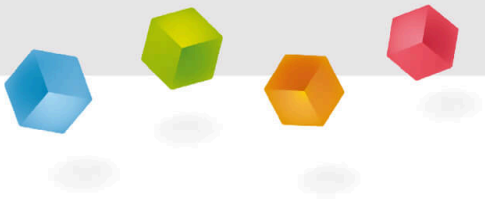

Student Information

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Motivation

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Fairy lights

Multi-outlet

From your everyday life you know many electrical devices that you plug into the socket so that they are supplied with electricity. However, the circuit up to the socket, but also in the devices themselves, often differs. Have you ever wondered how exactly this works?

For example, you can plug many devices into a multi-outlet, and if you unplug one of them, the others will still be powered.

However, many fairy lights go out completely if a single light bulb breaks.

In this experiment we want to investigate what the difference between these two examples is and what this means in everyday life.

Tasks

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You have a series and a parallel circuit with two lamps each. Now one of the two lamps fails, in which circuit does the other lamp also go out?

Series connection

Parallel connection

What are the differences between series and parallel circuit?

- Set up two light bulbs in a series circuit. Observe the brightness of the bulbs and the current flow. Remove one of the bulbs from the circuit and observe what happens.
- Set up two light bulbs in a parallel circuit. Again, observe the brightness and the current flow, then also remove one bulb and observe again.
- Go to the report section and answer the questions about the experiment

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Equipment

Position	Material	Item No.	Quantity
1	Flat battery, 4.5 V	07496-01	1
2	Connecting cord, 32 A, 250 mm, black	07360-05	6
3	Alligator clip	167700	2
4	Lamp holder, E10, with sockets	09390-06	2
5	Lamp 4 V/0,04 A,E 10 socket	06154-00	2
6	On/off switch for sciences sets	09390-07	1
7	Cobra SMARTsense - Current, ± 1 A (Bluetooth)	12902-00	1

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Set-up (1/3)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth** is **activated**.

iOS

Android

Windows

Set-up (2/3)

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Fig. 1

First build the series circuit as shown in Fig. 1.

Assemble the circuit in the following order:

battery - on/off switch - lamp holder - lamp holder - ammeter - battery

- You can plug the cords directly into the blue blocks and the ammeter.
- Clamp an alligator clip to each pole of the battery, you can then plug the cord in there.

Screw the two bulbs into the sockets.

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Set-up (3/3)

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Current sensor

Turn on your Cobra SMARTsense Current by pressing and holding the button on the sensor for 3 seconds.

Open the measure app on your tablet or smartphone.

Select the sensor "SMARTsense-Current" and set it to "Repeated Measurement".

Procedure (1/2)

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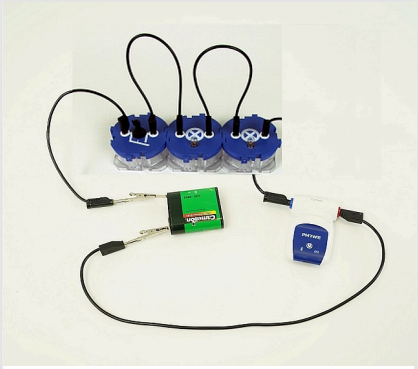

Fig. 1

Task 1

Go to the window with the digital display and select the channel "Current I".

- Observe the bulbs and measure the current with the meter
- Carefully unscrew one bulb
- Observe the light bulb in the circuit
- Write down your observations on a piece of paper.

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Procedure (2/2)

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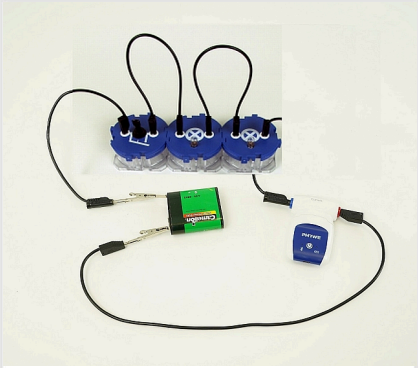

Fig. 2

Set up the parallel circuit as shown in Fig. 2. At the on/off switch and at the ammeter you have to plug the cords of the two light bulb sockets into each other.

Task 2

- Observe the bulbs and measure the current with the meter
- Carefully unscrew one bulb
- Observe the light bulb in the circuit
- Write down your observations on a piece of paper.

Switch the ammeter off again (turn the switch to "OFF").

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Report

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Task 1

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In which circuit does less current flow?

- Parallel circuit
- The same amount of current flows in both
- Series circuit

Task 2

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An example of the parallel circuit from everyday life is...

- the multi-outlet
- the fairy lights

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Task 3

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Summarize what you learned in this experiment.

The measured current is higher in the _____, therefore the lamps shine _____.
In the _____ the current is smaller and the lamps shine _____.
If a lamp is removed, in a series circuit the second bulb _____, in the parallel circuit it _____ to shine.

darker
series circuit
brighter
parallel circuit
continues
goes out

Check

Slide	Score / Total
Slide 8: Circuit types	0/1
Slide 16: Series and parallel connection	0/4
Slide 17: Series connection Everyday example	0/2
Slide 18: Various circuits	0/6

Total 0 / 13

Solutions Repeat

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