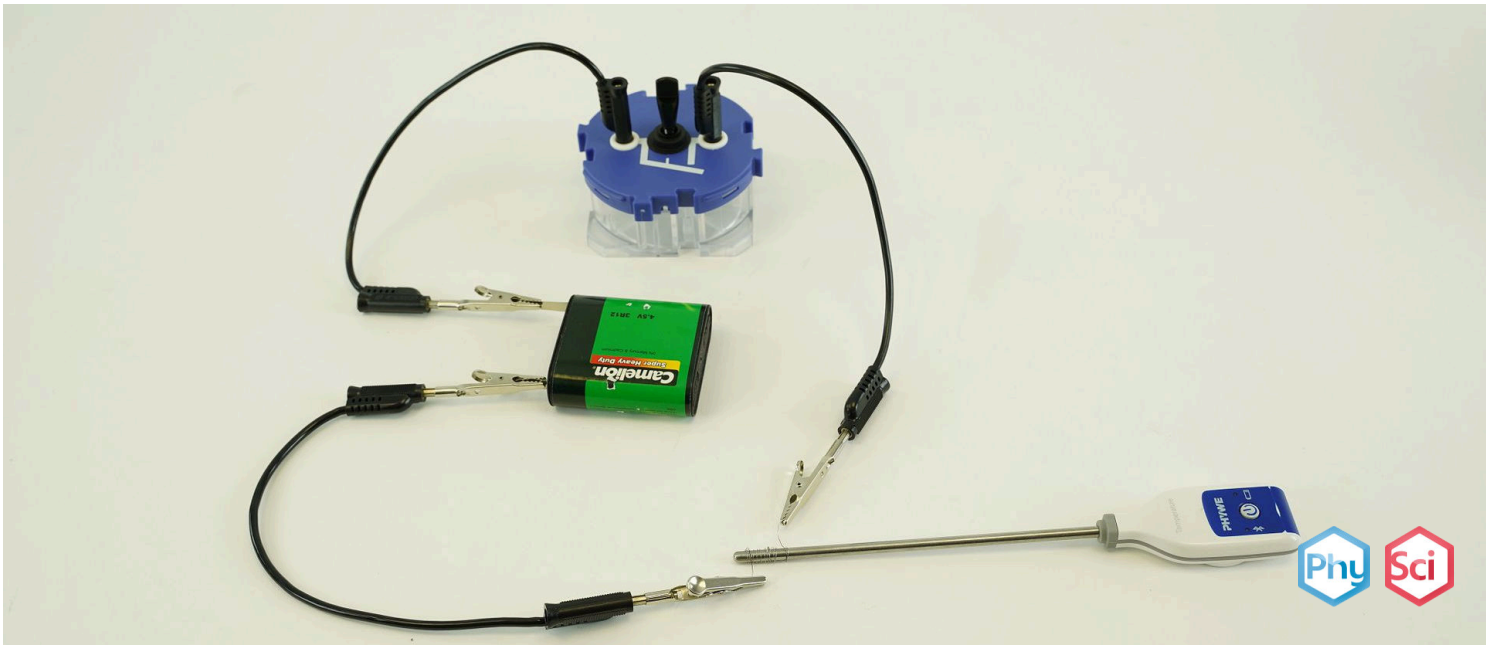
The thermal effect of the electric current with CobraSMARTsense



The students investigate the behaviour of a thin conductive wire in an electric circuit. They observe that the wire heats up as a result of the current flow. They conclude that electric current can be used specifically for heating, but also that heating can be an undesirable side effect of electric conductors.

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/605646b7a302c500039bf985

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Teacher information

Application

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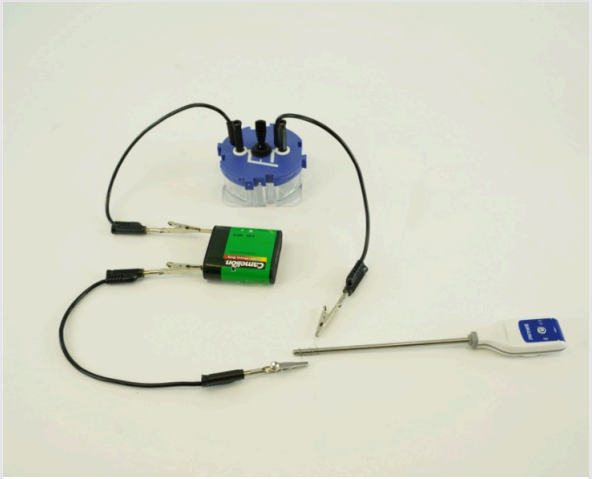

Experimental set-up

In this experiment, students investigate the behavior of a thin conductive wire in an electric circuit.

They observe that the wire heats up due to the current flow.

From this they conclude that electric current can be used specifically for heating, but also that heating can be an undesirable side effect of electric conductors.

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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. They know how to handle both the closed circuit and the temperature sensor with care.

Scientific principle

In this experiment, students observe that a wire carrying current heats up and observe the temperature rise in the measure app.

Notice: It is important that the wire windings are close to the meter, check student set-ups if necessary. Also, make sure that the students break the circuit again after observing the temperature rise!

Other teacher information (2/2)

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Learning objective

The students learn that a wire carrying electric current heats up. They understand that this effect can be exploited, but that in some cases it also leads to undesired losses.

Tasks

- The students build the given circuit
- To do this, they wrap the electrically conductive wire around the temperature sensor
- They observe the temperature as soon as current flows through the wire

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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 students break the circuit after observing the temperature rise, otherwise the battery will discharge quickly and the wire will become very hot
- The general instructions for safe experimentation in science lessons apply to this experiment.

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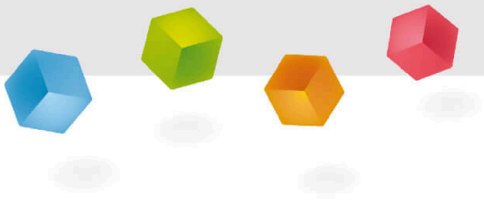

Student Information

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Motivation

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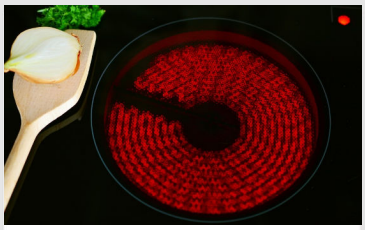
Light bulb



Stovetop

You have probably noticed that a light bulb that has been on for a while gets very hot, and the heat is actually an undesirable side effect.

However, there are many examples from everyday life where the heating of a wire is used. For example, the kettle heats with the help of a heating coil and in the stove plate are also wires that are brought to glow.

But how exactly does it work to heat a wire so strongly? We want to investigate this phenomenon in more detail in this experiment.

Tasks

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What do you suppose happens to a wire when electricity flows through it?

- It warms up.
- Nothing happens.
- It cools off.

Temperature change of a current-carrying wire

- Wrap an electrically conductive wire around the temperature sensor
- Observe the temperature as soon as current flows through the wire
- 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	3
3	Alligator clip	167700	4
4	On/off switch for sciences sets	09390-07	1
5	Cobra SMARTsense - Temperature, - 40 ... 120 °C (Bluetooth)	12903-00	1
6	Constantan wire, 15.6 Ohm/m, d = 0.2 mm, l = 100 m	06100-00	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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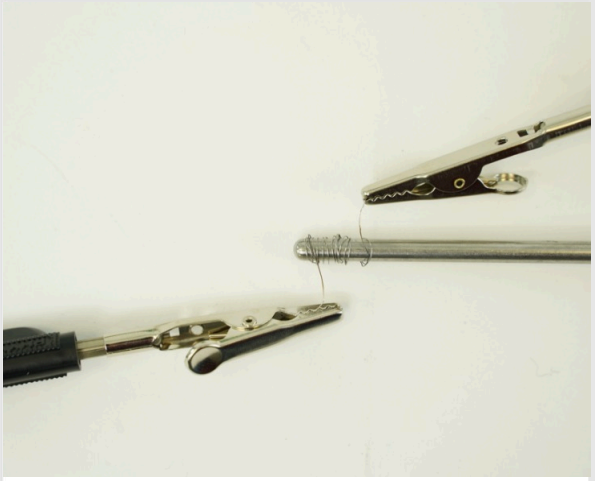

Fig. 1

First take a piece of wire, about 30 cm long. Wrap the wire several times around the end of the temperature sensor. Make sure that a piece of the wire protrudes at both ends, as in Fig. 1.

Now assemble the circuit as follows:

battery - on/off switch - wire - battery

connecting each of the parts with a cord. You will need alligator clips on the poles of the battery and the ends of the wire.

Check if your set-up corresponds to the one in fig. 2 (2 pages ahead).

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Set-up (3/3)

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Turn on your Cobra SMARTsense Temperature 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-Temperature".

Temperature sensor

Procedure

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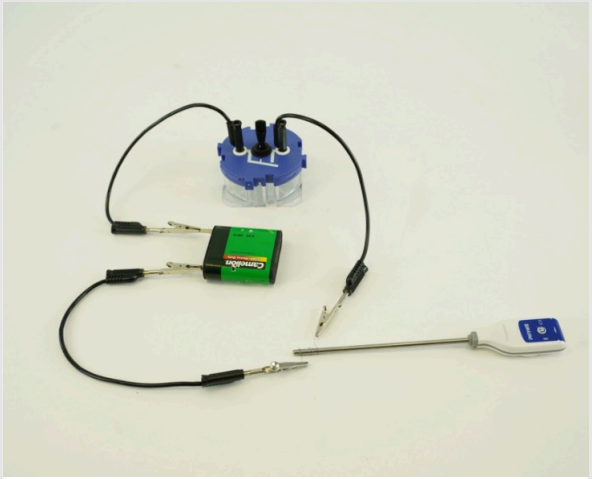

Fig. 2

First look at the temperature in the digital display and wait until the displayed value no longer changes.

Then go to the diagram window and start the measurement in the app.

Close the switch for about 30 seconds while watching the wire and the temperature graph in the app.

Watch the wire and temperature in the app for another 30 seconds and then stop the measurement.

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Report

Task 1

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If you let current flow through a wire, it will...

become colder.

not change its temperature.

become warmer.

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Task 2

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This effect is undesired in some applications because...

2 answers are correct!

- [ ] a hot wire does not conduct electricity as well.
- [ ] energy is thereby obtained.
- [ ] components can be damaged by the heat.

Check

Task 3

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Summarize what you learned in this experiment.

A wire that carries _____ becomes warmer over time.
If you switch _____ the current, the wire gradually becomes colder.
This effect can be used in everyday life, for example when using a _____. But it can also have negative consequences, for example when a light bulb gets _____ and energy is _____. Cables can also heat up if the current is too strong, and become _____ conductive.

current
off
water kettle
hot
less
lost

Check

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Slide	Score / Total
Slide 8: current through wire	0/1
Slide 15: Wire temperature	0/2
Slide 16: Undesirable effect	0/2
Slide 17: Summary	0/6

Total 0 / 11

Solutions Repeat

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