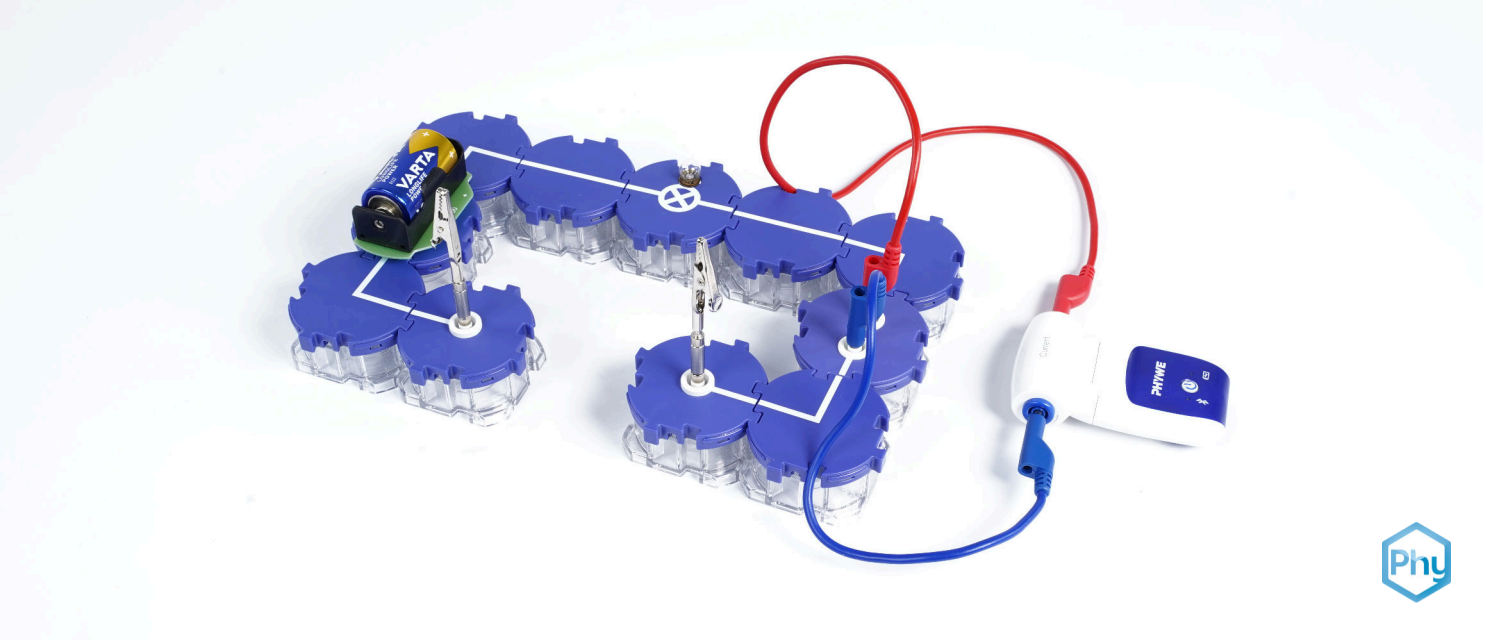
Conductors and non-conductors with Cobra SMARTsense



Physics > Electricity & Magnetism > Simple circuits, resistors & capacitors

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

This content can also be found online at:

https://www.curriculab.de/c/67f79959fea39e00023ea0fd

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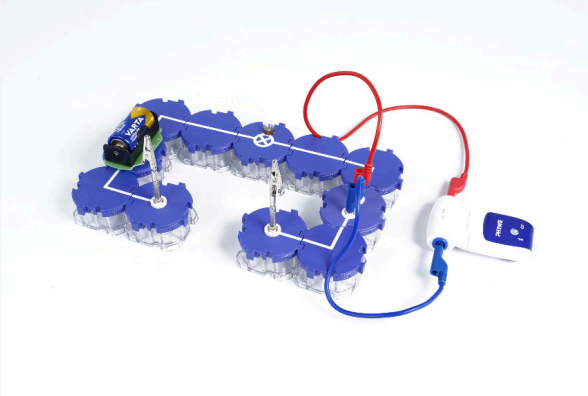
Teacher information

Application



Experimental setup

Electrical conductors are essential components in electrical engineering. Non-conductors (insulators) also play an important role by providing insulation and protecting us from electric currents.

The specific conductivity of a material primarily depends on its composition. However, temperature also affects conductivity. The temperature dependence, though, is not examined in this experiment.

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Other teacher information (1/2)

Prior knowledge

Students should know from everyday life that, for example, the wires for electrical cables in the home are surrounded by insulating layers to protect people from dangerous contact with live parts.

Principle

Conductivity depends on the material — hence the term specific conductivity. Depending on the material, the electrons are more or less free to move. In conductive materials (mainly metals), there are several electrons in the so-called conduction band, which can move relatively freely through the material, depending on the level of conductivity.

Other teacher information (2/2)

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Learning objective

The light bulb in the circuit serves to limit the current in solid materials and also provides an easy way to determine whether current is flowing. Due to the relatively short lengths and large diameters of the investigated "wires", the currents do not vary significantly when testing the group of metals. It is primarily important to qualitatively assess whether a substance is conductive or not.

Tasks

Students should incorporate metallic and non-metallic materials into a simple circuit and analyse their conductivity.

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Safety instructions

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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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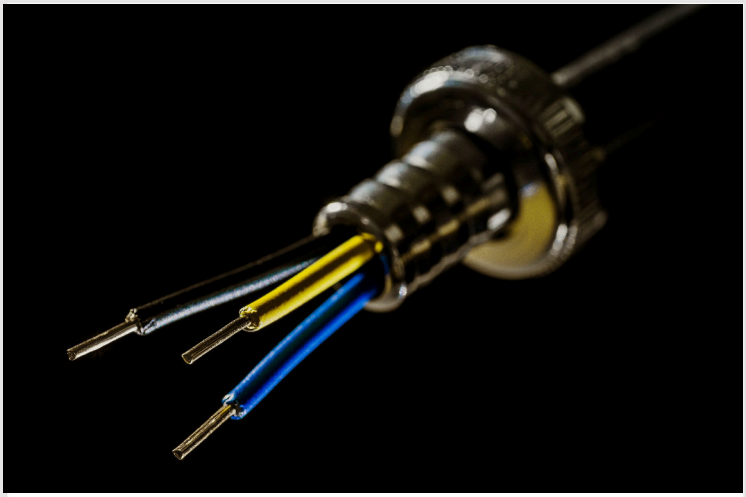

Cable with insulation

To charge your smartphone, you need a charging cable that connects your smartphone's battery to the power supply. But why don’t you get an electric shock if you touch the cable while plugging it into the socket? As you may know, this is because the conductive wires are surrounded by insulation.

In this experiment, you will learn what conductivity is and which typical materials can and cannot conduct electricity.

Tasks

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Build a simple interrupted circuit with crocodile clips and investigate which of the given materials conduct electricity and which do not.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Current - Sensor for measuring electrical current ± 1 A (Bluetooth + USB)	12902-02	1
2	Straight connector module, SB	05601-01	2
3	Angled connector module, SB	05601-02	4
4	Interrupted connector module with sockets, SB	05601-04	2
5	Junction module, SB	05601-10	2
6	Socket module for incandescent lamp E10, SB	05604-00	1
7	Battery holder module (C type), SB	05605-00	1
8	Conductors/non-conductors, l = 150 mm	06107-15	1
9	Alligator clips, bare, 10 pcs	07274-03	1
10	Connecting plug, 2 pcs.	07278-05	1
11	Connecting cord, 32 A, 250 mm, red	07360-01	1
12	Connecting cord, 32 A, 250 mm, blue	07360-04	1
13	Connecting cord, 32 A, 500 mm, red	07361-01	1
14	Connecting cord, 32 A, 500 mm, blue	07361-04	1
15	Battery Type C 1.5 V - Pack of 2 pieces	07400-00	1
16	Filament lamps 1.5V/0.15A,E10,10 pieces	06150-03	1
17	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Setup (1/4)

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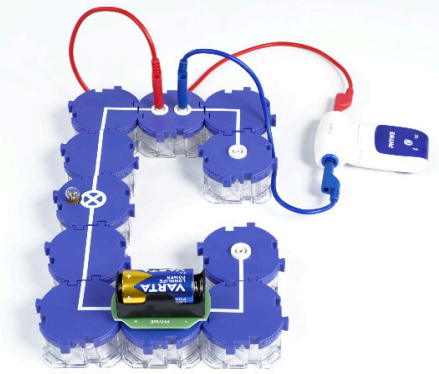

Experimental setup

- Set up the experiment as shown in the illustrations on the left. Insert the $1.5\ \mathrm{V}$ battery and the $1.5\ \mathrm{V}$ light bulb.
- Then plug the crocodile clips into the connection sockets using the connecting plugs. You can see what this should look like by pressing the blue button.

Setup (2/4)

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To measure with the **Cobra SMARTsense sensors**, the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the respective app store (QR codes below). Please check that **Bluetooth is enabled** on your device (smartphone, tablet, desktop PC) before starting the app.

iOS

Android

Windows

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Setup (3/4)

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Experimental setup

- Switch on the Cobra SMARTsense Current by pressing the on/off button for three seconds.
- Then open the measureAPP and connect to the Cobra SMARTsense Current. Switch to the measured value display, where the values are displayed as numbers. The photo on the left shows what this looks like.

Setup (4/4)

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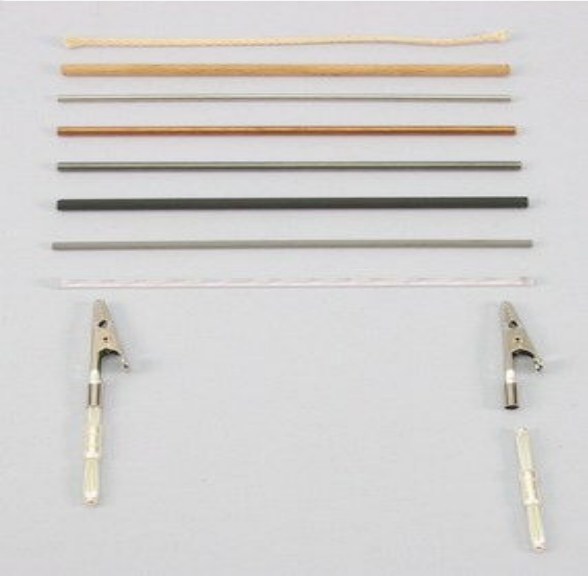

- The materials (conductors and non-conductors) are analysed one after the other. These are the following materials (from top to bottom as shown in the adjacent figure):
  - A cord made of cotton, wood, aluminium (silvery), copper (reddish), steel (like aluminium but heavier and darker), coal (black), PVC (plastic) and glass.

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Procedure (1/2)

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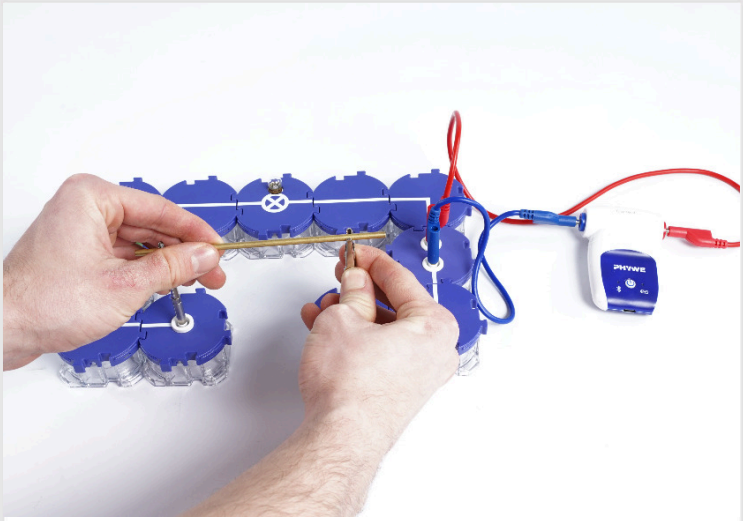

Insertion of a (non-)conductor

- Clamp the individual rods of the conductor and non-conductor set into the two crocodile clips at both ends one after the other (not yet the cord).
- The following applies to each rod: Observe the brightness of the lamp and measure the amperage I.
- Note your measured values in the log.

Procedure (2/2)

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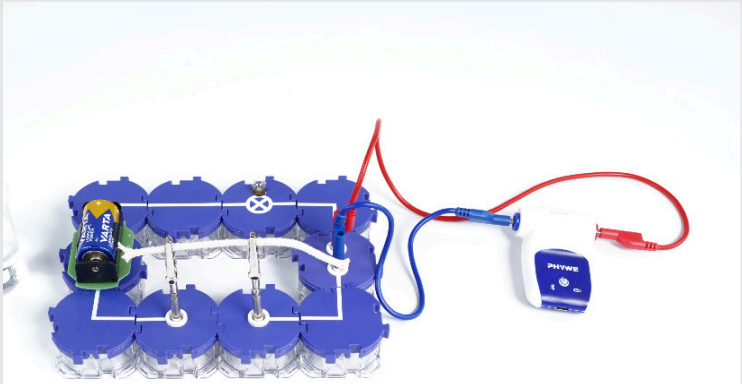

Inserting the cotton cord

- Now reduce the experimental setup as shown in the adjacent illustration. Finally, clamp the cotton cord and proceed in the same way as before. Note your measured values in the protocol

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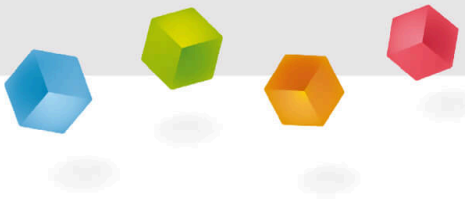

Report

Table 1

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Fabric	Lamp brightness	$I\,[\mathrm{mA}]$
Steel		
Aluminium		
Copper		
PVC		
Glass		
Wood		
Coal		
Cotton		

Enter your measured values in the table.

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Task 1

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Metals conduct electricity.

○ True ○ False

Check

The following substances are non-conductors:

- ☐ Copper
- ☐ Steel
- ☐ Cotton
- ☐ Glass
- ☐ PVC

Check

Task 2

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Which of the following are examples of insulators to protect against electric shocks?

- ☐ Rubber sole for safety shoes
- ☐ Plastic sheathing of cables
- ☐ Plastic handles for voltage testers and screwdrivers

Check

You may work with electrical appliances and systems if they are damp.

○ True ○ False

Check

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Slide	Score / Total
Slide 18: Multiple tasks	0/4
Slide 19: Multiple tasks	0/4

Total amount 0 / 8

Solutions | Repeat | Export text

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