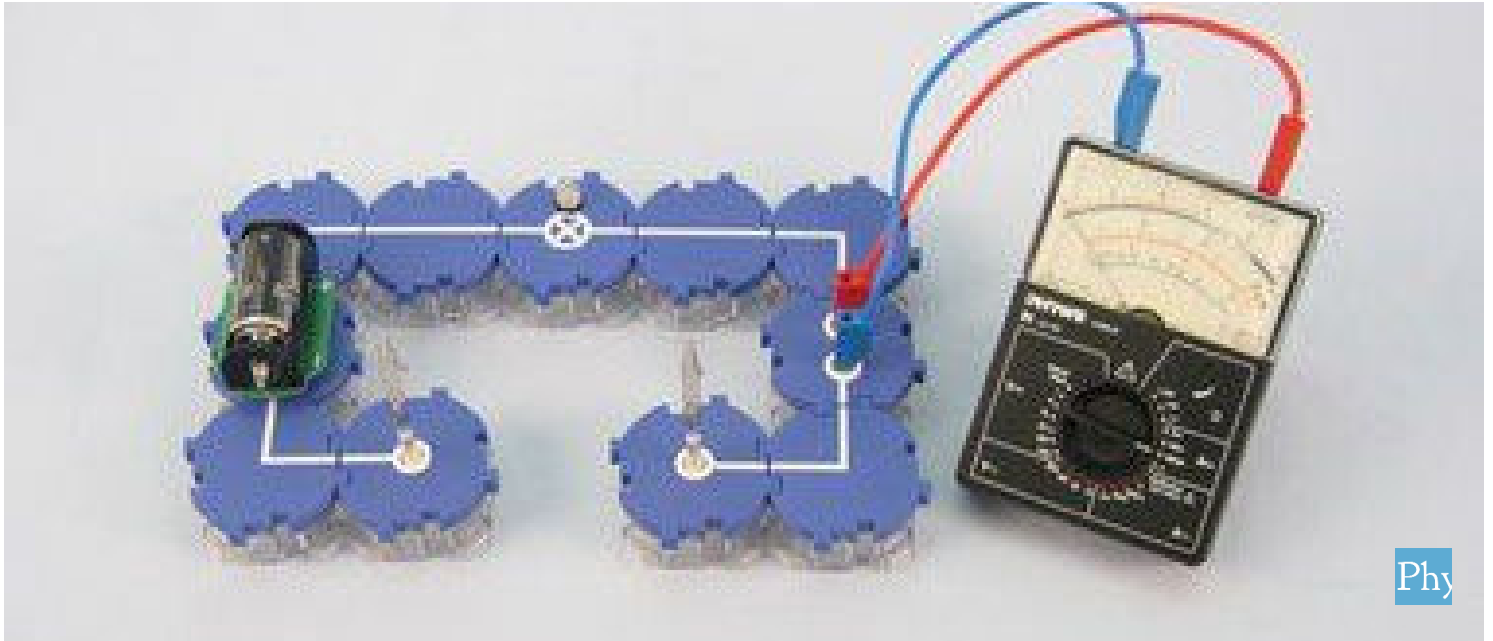


Conductors and non-conductors



Physics

Electricity & Magnetism

Simple circuits, resistors & capacitors



Difficulty level

easy



Group size

2



Preparation time

10 minutes



Execution time

10 minutes

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Teacher information

Application

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Experiment set-up

In electrical engineering, electrical conductors are essential components. Non-conductors also have their uses by insulating and protecting us from electrical currents.

The specific conductivity is primarily dependent on the material. However, in addition to the material, the temperature of the material also plays a role. The temperature dependence is not investigated in this experiment.

Other teacher information (1/2)

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Prior knowledge



The pupils should know from everyday life that e.g. in the household the wires for electric lines are surrounded by insulating layers and thus people are protected from dangerous contact with live parts.

Scientific principle



The conductivity depends on the material, therefore we are talking about the specific conductivity. Depending on the material, the electrons are freer and therefore also more mobile. In conductive materials (mainly metals) there are several electrons in the so-called conduction band, depending on the conductivity, which can move more or less freely in the material.

Other teacher information (2/2)

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Learning objective



The light bulb in the circuit is used to limit the current in the solids and also to make a simple decision as to whether current is flowing or not. Due to the relatively short lengths and large diameters of the examined "wires", the current intensities do not differ from each other when examining the group of metals; it is only important to qualitatively recognize whether a substance is conductive or not.

Tasks



The students are to integrate metallic and non-metallic materials into a simple electric circuit and examine their conductivity. When investigating the conductivity of a wet cord, the students should not only investigate that normal drinking water also conducts electricity, but also experience impressively how important it is to choose the most favourable measuring range.

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

Motivation

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Cable with insulation

For example, to charge your smartphone, you need a charging cable that connects the battery of your smartphone to the mains. 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 cables are surrounded by insulation.

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

Tasks

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

Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	2
2	Angled connector module, SB	05601-02	4
3	Interrupted connector module with sockets, SB	05601-04	2
4	Junction module, SB	05601-10	2
5	Socket module for incandescent lamp E10, SB	05604-00	1
6	Battery holder module (C type), SB	05605-00	1
7	Conductors/non-conductors, l = 150 mm	06107-50	1
8	Alligator clips, bare, 10 pcs	07274-03	1
9	Connecting plug, 2 pcs.	07278-05	1
10	Connecting cord, 32 A, 250 mm, red	07360-01	1
11	Connecting cord, 32 A, 250 mm, blue	07360-04	1
12	Connecting cord, 32 A, 500 mm, red	07361-01	1
13	Connecting cord, 32 A, 500 mm, blue	07361-04	1
14	Battery cell, 1.5 V, baby size, type C	07922-01	1
15	Filament lamps 1.5V/0.15A,E10,10 pieces	06150-03	1
16	Analog multimeter, 600V AC/DC, 10A AC/DC, 2 M Ω , overload protection	07021-11	1

Additional equipment

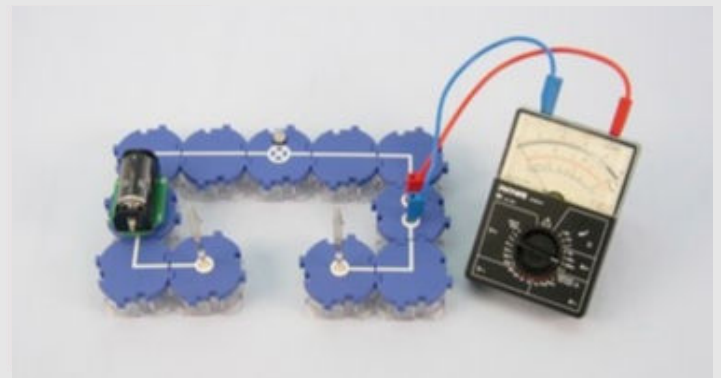
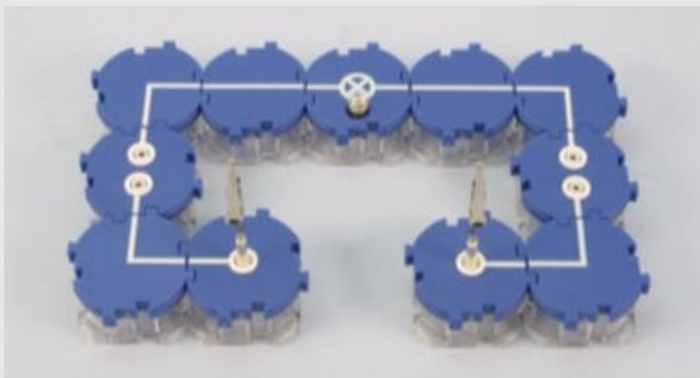
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Position	Equipment	Quantity
1	Mugs	1
2	Water	approx. 100ml
3	Common salt	approx. 1/2 teaspoon

Set-up (1/2)

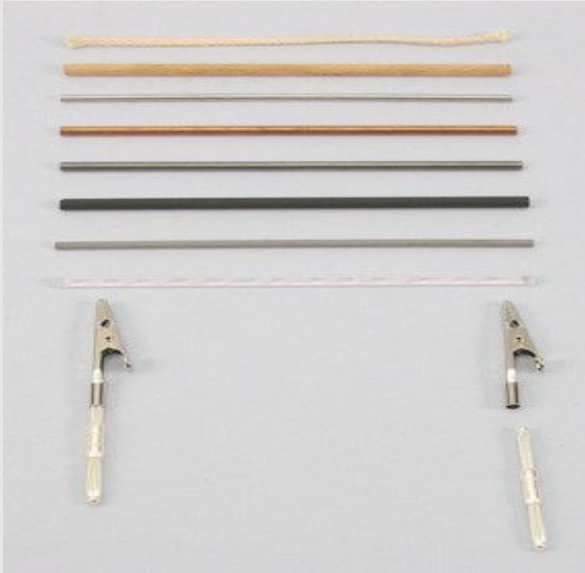
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- Set up the experiment according to the figures below. Insert the 1.5 V battery and the 1.5 V bulb. Plug the crocodile clips into the connection sockets with the aid of connecting plugs.
- Select a measuring range of 300 mA direct current on the measuring instrument (observe polarity).



Set-up (2/2)

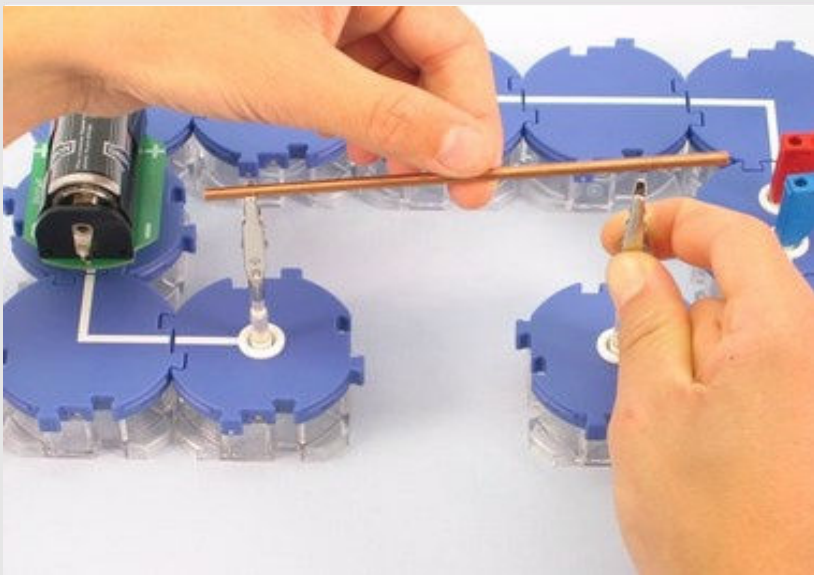
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- The materials (conductor and non-conductor) are examined one after the other. The following materials are involved (according to the adjacent figure from top to bottom):
 - A cord made of cotton, wood, aluminium (silvery), copper (reddish), steel (like aluminium but heavier and darker), carbon (black), PVC (plastic) and glass.

Procedure (1/3)

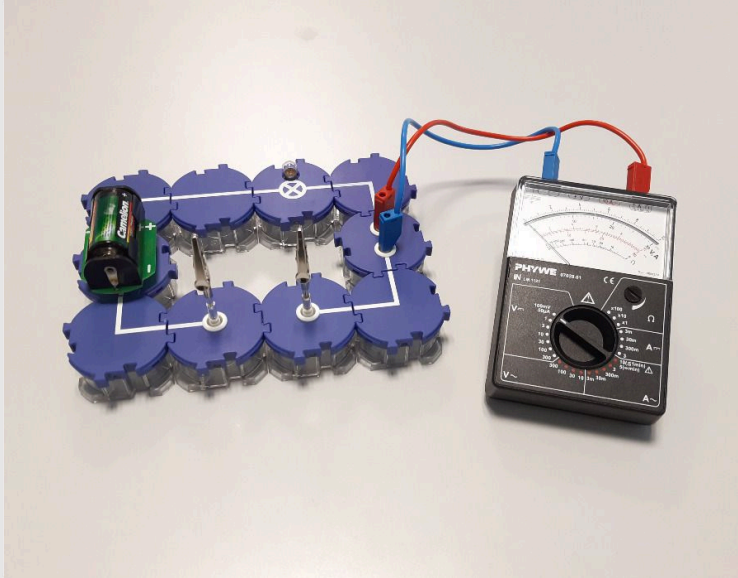
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- Clamp the individual sticks of the set conductor and non-conductor one after the other at both ends into the two crocodile clips (the cord not yet).
- For each rod: Observe the brightness of the lamp and measure the current I .
- Note your readings in the log.

Procedure (2/3)

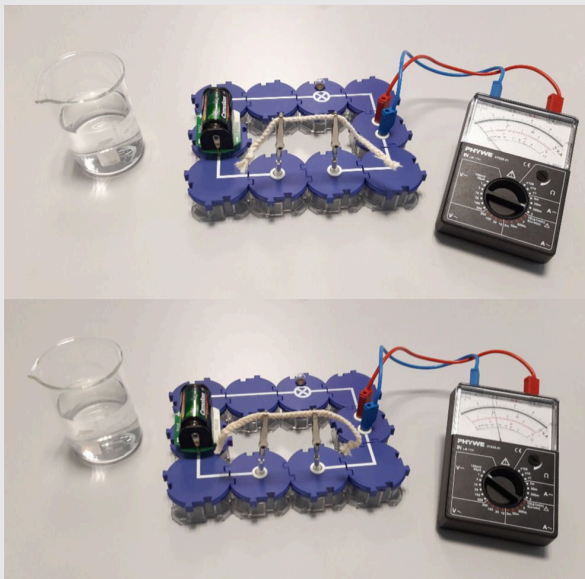
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- Now reduce the size of the test setup according to the adjacent figure. Now clamp the cotton cord last and proceed in the same way as before. Note your measured values in the protocol.
- Remove the cotton cord again, make it completely wet with tap water and clamp it back into the crocodile clips.
- Observe the lamp and measure the current again. The measuring range should be reduced to the range $50 \mu\text{A}$.

Procedure (3/3)

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- Prepare a saltwater solution: about 1/2 teaspoon of salt to about 100 ml of water. Make sure that the salt is completely dissolved.
- Immerse the cord again completely in the water. Squeeze the cord slightly everywhere to make sure that the cord is completely soaked with the salt solution.
- Then carry out the measurement in the same way as before.
- After the test, the cord should be well washed and dried.

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Report

Table 1

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Substance	Lamp Brightness	I [mA]
-----------	-----------------	----------

Steel		
-------	--	--

Aluminium		
-----------	--	--

Copper		
--------	--	--

PVC		
-----	--	--

Glass		
-------	--	--

Wood		
------	--	--

Coal		
------	--	--

Enter your measured values in the table.

Table 2

Cotton cord Lamp Brightness I [mA]

dry

with tap water

with salt water

Enter your measured values in the table.

Task 1

Metals conduct electricity.

True

Wrong

Check

The following substances are non-conductors:

Steel

Cotton

PVC

Copper

Glass

Check

Task 2

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Which cord conducts the electric current better?

- None of the cords conduct electricity at all.
- All cords conduct equally well, whether dry or wet.
- The cord with salt water conducts better than the cord with tap water.
- The dry cord conducts better than the wet one, because air conducts electricity better than water.
- The wet cord conducts better than the dry one, as water conducts electricity better than air.

✓ Check

Task 3

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Which of the following examples are insulators for protection against electric shock?

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

✓ Check

You may work with electrical equipment and installations if they are damp.


True

Wrong

✓ Check

Slide	Score/Total
Slide 19: Multiple tasks	0/4
Slide 20: Conductivity of the cord	0/2
Slide 21: Multiple tasks	0/4

Total amount  0/10

 Solutions

 Repeat

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