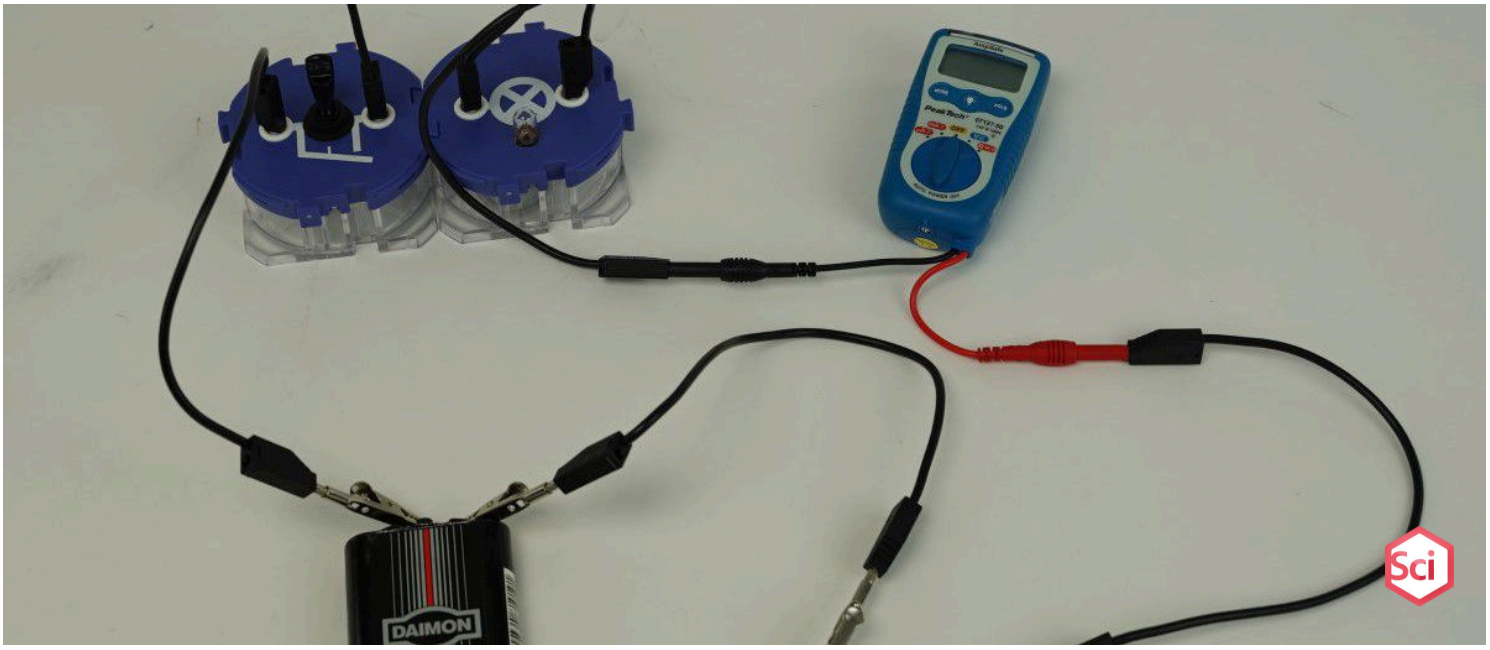
Conductive and non-conductive materials



In this experiment, students learn that different materials have different properties in terms of conductivity.

Nature & technology > Substances in everyday use

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/62693e673be17c00032ed6db

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Teacher information

Application

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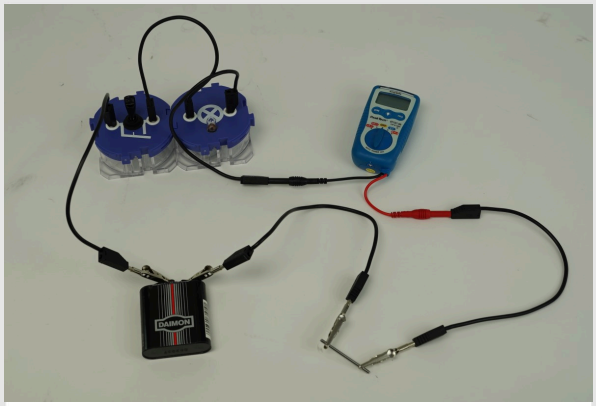

Test setup

In this experiment, the students examine the electrical conductivity of various substances. Substances that conduct electricity are called conductors; substances that do not conduct electricity are called non-conductors or insulators.

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Other teacher information (1/3)

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Prior

Students should already have a good, basic theoretical knowledge of conductive and non-conductive materials.

Principle

Various substances are bound into an electric circuit and examined for their conductivity.

Other teacher information (2/3)

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Learning

In this experiment, students learn that different materials have different properties in terms of conductivity.

Tasks

The students build the circuit and insert different rods. They then insert a beaker into the circuit and fill it with different liquids.

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Other teacher information (3/3)

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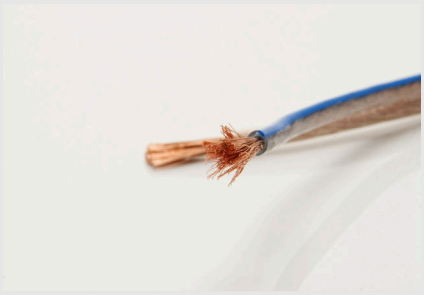
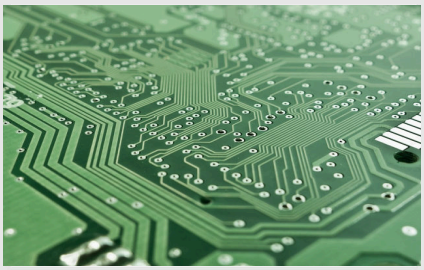
Application

- Conductors are used to allow the electric current to flow. Non-conductors often enclose them to prevent danger to people.
- The circuit board in a smartphone or computer consists of many electrical lines that are separated from each other by non-conductive layers. This prevents the various circuits from interfering with each other.
- Not only solids, but also liquids or substances dissolved in water can conduct electricity. Substances that do not actually conduct electricity can become conductors when they are wet!





Safety instructions

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The general instructions for safe experimentation in science education apply to this experiment.

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Student Information

Motivation

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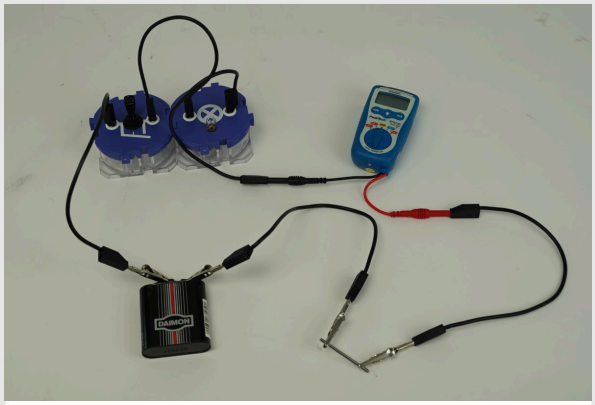

Test setup

Perhaps you have already touched an electrically charged pasture fence and received a (painful) electric shock. The electric fence is usually powered by a battery, and the battery is connected to the fence via a power cable.

If you touch this cable, you do not feel an electric shock, although electric current is conducted through the cable as well as through the pasture fence. How can this phenomenon be explained?

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Tasks

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In this experiment, you want to investigate the electrical conductivity of different substances and test which ones conduct electricity.

\You already know that electric current only flows through a closed circuit. Put different substances into a circuit and observe whether a light bulb in the circuit lights up and whether current flows.

1. Build the circuit and insert different rods.
2. Insert a beaker into the circuit and fill it with different liquids.

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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	5
3	Alligator clip	167700	4
4	Lamp holder, E10, with sockets	09390-06	1
5	Lamp 4 V/0,04 A,E 10 socket	06154-00	1
6	On/off switch for sciences sets	09390-07	1
7	PHYWE Digital student multimeter AmpSafe, 600V AC/DC, 200mA AC/DC, 20 MΩ, electronic overload protection	07127-00	1
8	Conductors/non-conductors,l-50 mm	06107-01	1
9	Beaker, 50 ml, plastic (PP)	46273-01	1
10	Water, distilled 5 l	31246-81	1
11	Sodium chloride 250 g	30155-25	1
12	D (+)-Sucrose 100 g	30210-10	1
13	Spoon,stainless steel,210mm	40874-00	1
14	Glass rod,boro 3.3,l=300mm, d=9mm	40485-07	1

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Structure and implementation

Structure (1/2)

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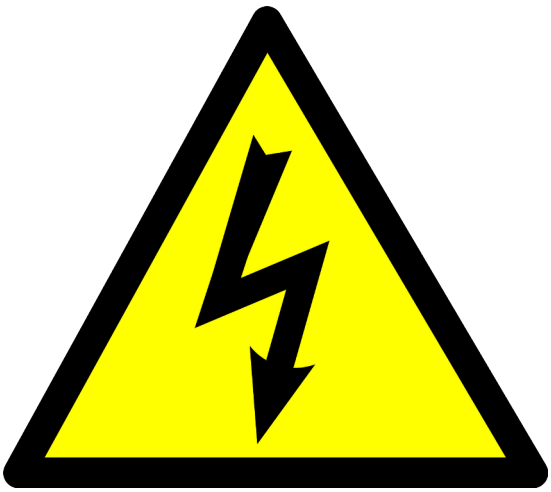

- Make sure that the on/off switch is turned off before connecting the battery. To do this, move the lever up.
- This ensures that no current flows through the circuit. Set the switch only during the measurement and switch it off again afterwards.
- Only change the setup when the on/off switch is turned off!

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Structure (2/2)

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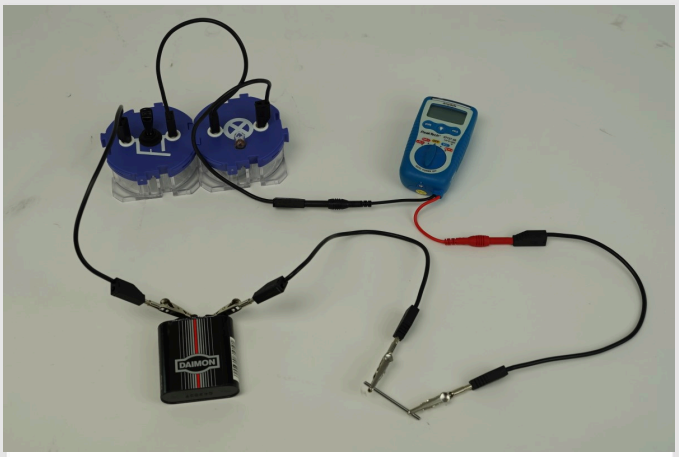
Assemble the circuit in the following order:

- Battery - On/Off switch - Lamp holder - Ammeter - Conductors and non-conductors (start with a rod of your choice) - Battery

Connect each of the parts with a cable.

- You can plug the cables directly into the blue blocks and the current meter.
- Clamp an alligator clip to the poles of the battery and the ends of the rods. You can then insert the cable there.

Place the bulb in the lamp socket.



Test setup

Implementation (1/4)

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For the measurements, turn on the ammeter by turning the switch to "mA". Press the "Mode" key until the screen displays "DC".

- Investigate the behavior of the different rods from the set "Conductors and non-conductors". Start with the rod that you inserted into the circuit under "Structure".
- Switch on the on/off switch. The circuit is now closed!
- Observe the bulb and measure the current with the meter.
- Turn the on/off switch off again!
- Then remove the rod from the circuit and insert the next rod.
- Repeat the measurement for all the rods in the set. Make sure that the switch is always turned off when replacing the rods and record your observations in the table in the results section.

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Implementation (2/4)

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- Now take out the last rod. Instead, clamp the cables onto the rim of the cup as in the illustration on the right.
- Fill the beaker completely with table salt and switch on the on/off switch. The circuit is now closed!
- Observe the bulb and measure the current with the meter.
- Turn the on/off switch off again!
- Remove the table salt completely from the beaker again. Repeat the measurement with sugar and then remove the sugar again.

Implementation (3/4)

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- Pour as much distilled water into the beaker until it touches both alligator clips.
- Switch on the on/off switch. The circuit is now closed!
- Observe the bulb and measure the current with the meter.
- Turn the on/off switch off again!
- Record your observations in the table in the log.

- Add a teaspoon of salt to the beaker filled with distilled water. Using the stirring rod, stir the water so that

  sich the salt dissolves and there is nothing left of it.
- Switch on the on/off switch. The circuit is now closed!
- Observe the bulb and measure the current with the meter.
- Turn the on/off switch off again!

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Procedure (4/4)

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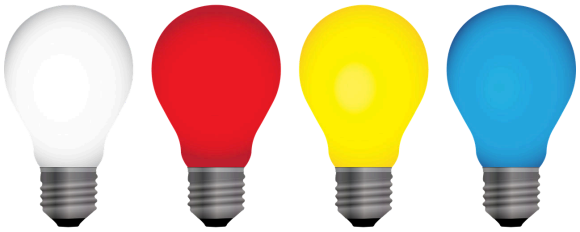
- Empty the cup and rinse it out.
- Then fill it again with distilled water and add a teaspoon of sugar. Dissolve the sugar and repeat the measurement.
- Record your observations in the log.
- Turn off the ammeter again by turning the switch to "OFF".



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Report

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Task 1

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Record your observations from the experiment in the table.

	Is the lamp lit?	Current (mA)		Is the lamp lit?	Current (mA)
1			6		
2			7		
3			8		
4			9		
5			10		

Task 2

PHYWE

Does the lamp always light up when you have one of the sticks plugged into the circuit?

- ○ No, the lamp does not always light up. For example, when a plastic rod was clamped into the circuit, it remained off.
- ○ No, the lamp never lights up. This is because there is no cable where the rod was clamped into the circuit. Only cables conduct electricity.
- ○ Yes, the lamp always lights up when one of the sticks is clamped into the circuit.

Check

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Task 3

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Compare your measurements. What did the meter read when the lamp was lit? What does it mean?

Task 4

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You probably already know that metals conduct electricity. Conversely, are all non-metals also non-conductors?

- ○ This is wrong. Only liquids conduct electricity, so you should leave the pool during thunderstorms.
- ○ That is correct. Only metals can conduct electricity.
- ○ No. The salt solution, for example, is not metal, yet it conducted the current and the lamp lit up.

Check

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Task 5

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In the experiment, you investigated the electrical conductivity of salt water and sugar water. What did you notice? Did the observation perhaps even surprise you?

Task 6

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Choose the correct answers.

- ☐ The substances for which the lamp does not shine are called insulators.
- ☐ The substances for which the lamp shines are called insulators.
- ☐ The substances where the lamp does not shine are called conductors.
- ☐ Conductors are used to allow the electric current to flow. Non-conductors often enclose them to prevent danger to people.

Check

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Slide	Score / Total
Slide 20: Is the lamp always on?	0/1
Slide 22: Non-metals = non-conductors?	0/1
Slide 24: Conductor or insulator?	0/2

Total 0 / 4

Solutions | Repeat | Export text

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