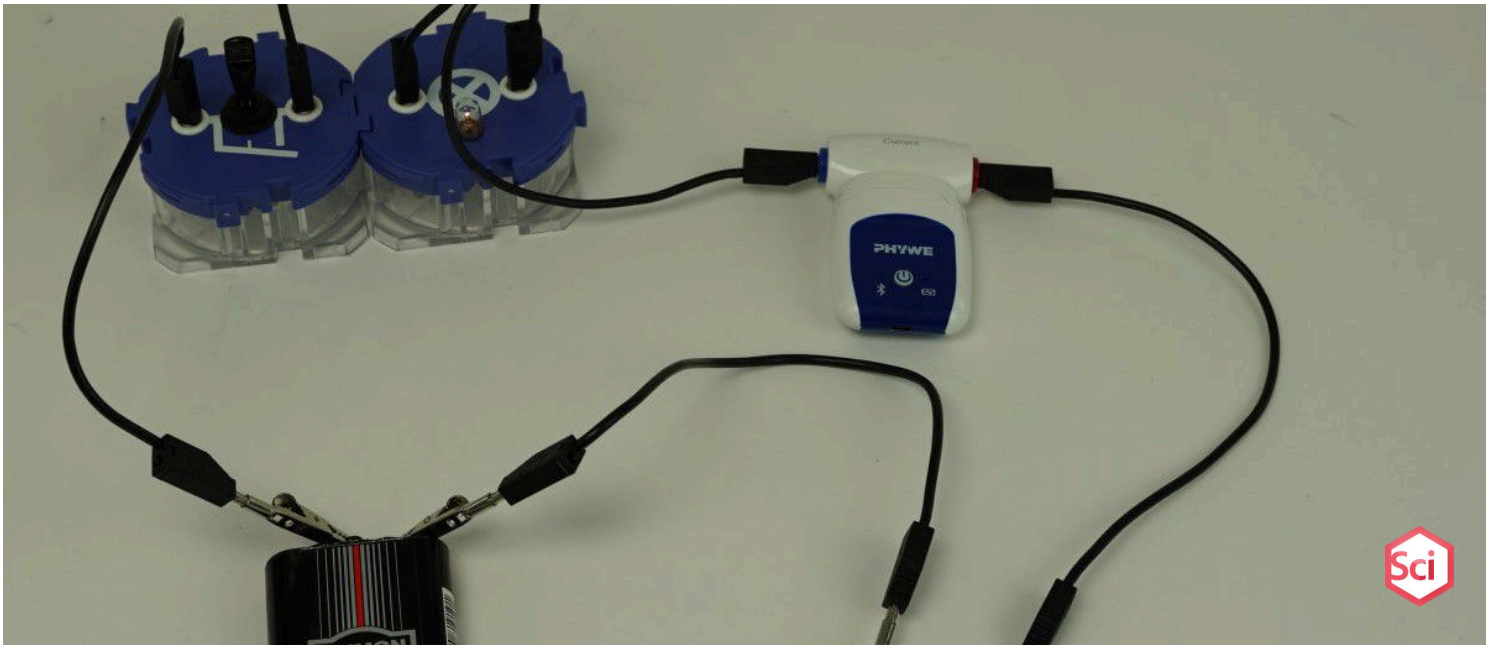
# Conductive and non-conductive materials with Cobra SMARTsense




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

Nature & technology > Devices & machines 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/611e02b97f92610003544ed8

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# Teacher information

## Application

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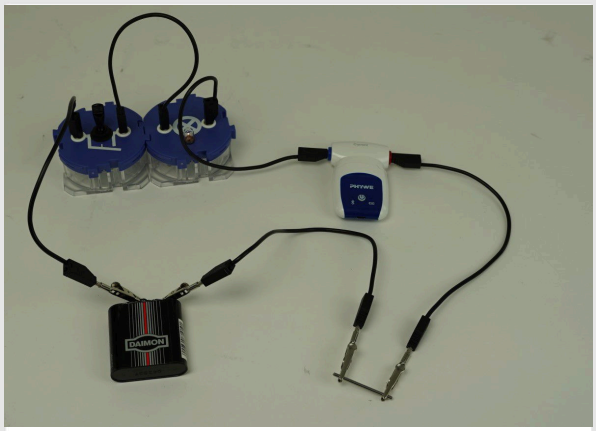

Experiment setup

In this experiment, the students examine the electrical conductivity of various substances. To do this, they use the Cobra SMARTsense Current to observe and record the measurement data in real time. Substances that conduct electricity are called conductors; substances that do not conduct electricity are called non-conductors or insulators.



PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

## Other teacher information (1/3)

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**Prior knowledge**

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

**Scientific Principle**

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

## Other teacher information (2/3)

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**Learning objective**

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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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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# Other teacher information (3/3)

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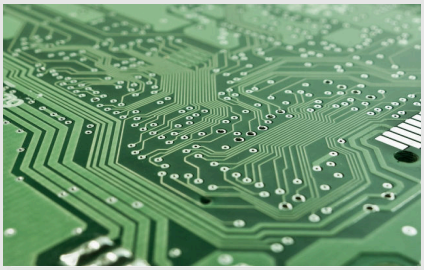
**Application**

- 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 lessons to be applied to this experiment.



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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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# Student Information

## Motivation

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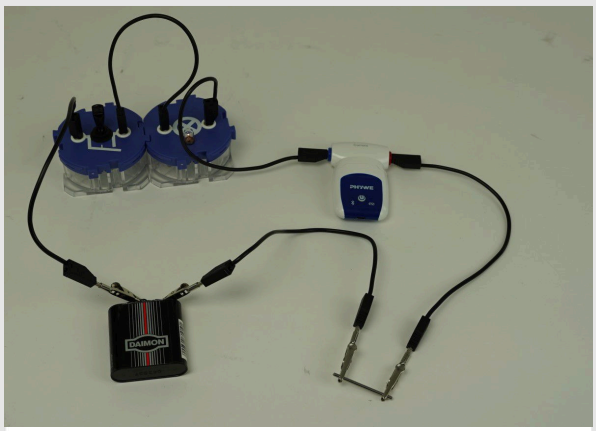

Experiment setup

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, which 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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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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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 materials 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. Place a beaker in the circuit and fill it with various liquids.



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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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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 | Conductors/non-conductors,l-50 mm | 06107-01 | 1 |
| 8 | Beaker, 50 ml, plastic (PP) | 46273-01 | 1 |
| 9 | Water, distilled 5 l | 31246-81 | 1 |
| 10 | Sodium chloride 250 g | 30155-25 | 1 |
| 11 | D (+)-Sucrose 100 g | 30210-10 | 1 |
| 12 | Spoon,stainless steel,210mm | 40874-00 | 1 |
| 13 | Glass rod,boro 3.3,l=300mm, d=9mm | 40485-07 | 1 |
| 14 | Cobra SMARTsense - Current, ± 1 A (Bluetooth + USB) | 12902-01 | 1 |



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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
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# Structure and procedure

## Structure (1/4)

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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



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## Structure (2/4)

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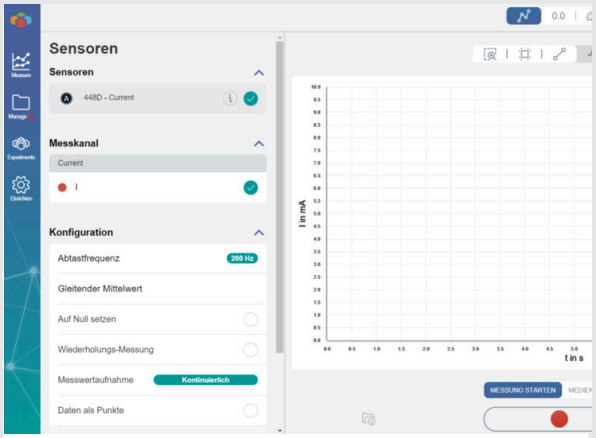


Connected SMARTsense current sensor in the Windows 10 version of measureAPP.

- Turn on the SMARTsense current sensor by pressing and holding the power button.
- Connect the sensor to the device in the measureAPP under the item "Measure".
- The SMARTSense sensor is now displayed in the app.

## Structure (3/4)

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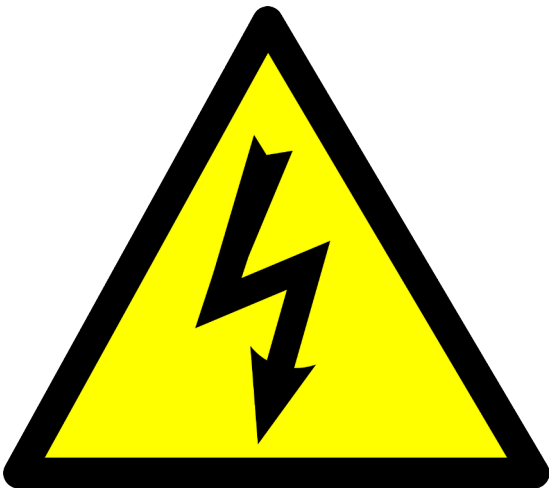

- Make sure that the on/off switch is turned off before connecting the battery. To do this, move the lever up.
- This ensures that no current flows through the circuit. Set the switch only during the measurement and switch it off again afterwards.
- Only change the setup when the on/off switch is turned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



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Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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## Structure (4/4)

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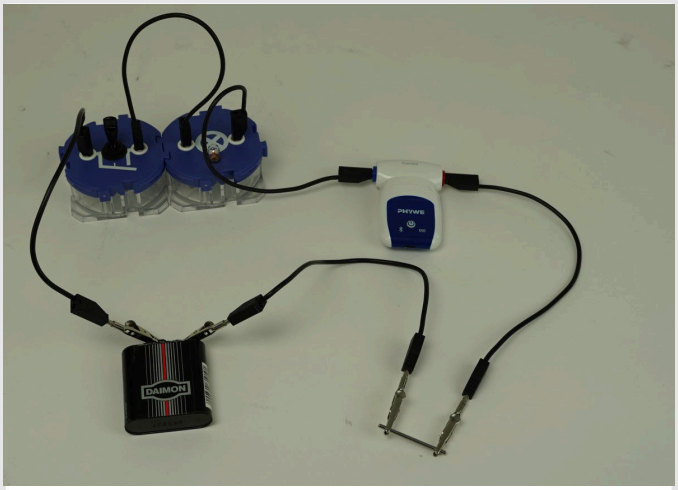
Assemble the circuit in the following order:

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

Connect the parts with a cable each.

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

Put the bulb in the lamp socket.




Test setup

## Procedure (1/4)

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Press the button "Record" in measureAPP for the measurement.

- Investigate the behavior of the different rods in the "Conductors and Non-Conductors" set. Start with the rod that you inserted into the circuit under "Build".
- Turn on the on/off switch. The circuit is now closed!
- Observe the lightbulb and measure the current with the meter.
- Turn the on/off switch off again!
- Then take the rod out of 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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Robert-Bosch-Breite 10
37079 Göttingen

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Fax: 0551 604 - 107

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## Procedure (2/4)

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- Now take out the last rod. Instead, clamp the cables onto the rim of the cup as shown in the picture 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. Repeat the measurement with sugar and then remove the sugar again.


## Procedure (3/4)

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- Pour enough distilled water into the beaker until it touches both alligator clips.
- Turn 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 cup filled with distilled water. Stir the water with the stirring rod, so that the salt will be dissolved and there is nothing left of it.
- Turn 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!



PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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## Procedure (4/4)

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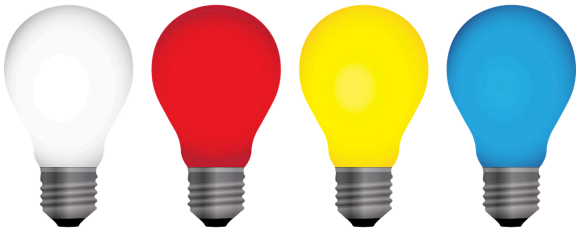
- Empty the cup and rinse it out.
- Then fill it again with distilled water and add a teaspoon of sugar. Dissolve the sugar and repeat the measurement.
- Record your observations in your report.



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# Report



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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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## Task 1

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Enter your observations from the experiment in the table.

| | Is the light on? | Current (mA) | | Is the light on? | Current (mA) |
|---|---|---|---|---|---|
| 1 | | | 6 | | |
| 2 | | | 7 | | |
| 3 | | | 8 | | |
| 4 | | | 9 | | |
| 5 | | | 10 | | |

## Task 1

PHYWE

Enter your observations from the experiment in the table.

| | Is the light on? | Current (mA) | | Is the light on? | Current (mA) |
|---|---|---|---|---|---|
| 1 | | | 6 | | |
| 2 | | | 7 | | |
| 3 | | | 8 | | |
| 4 | | | 9 | | |
| 5 | | | 10 | | |



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Robert-Bosch-Breite 10
37079 Göttingen

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Fax: 0551 604 - 107

info@phywe.de
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## Task 2

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Does the light goes on when you have one of the sticks plugged into the circuit?

- ○ No, the lamp never lights up. That's because there is no wire where the stick was clamped into the circuit. Only cables conduct electricity.
- ○ Yes, the light always goes on when one of the sticks is plugged into the circuit.
- ○ No, the light doesn't goes always on . For example, if a plastic rod was clamped in the circuit, it remained off.

Check

## Task 3

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Compare your results and observations. What did the meter read when the light was on? What does that mean?



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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
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## Task 4

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

- ○ No. The salt solution, for example, is not metal, yet it conducted the current and the lamp was on.
- ○ That's wrong. Only liquids conduct electricity, so you should leave the pool during a thunderstorm.
- ○ That's right. Only metals can conduct electricity.

Check

## Task 5

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



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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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# Task 6

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Choose the correct answers.

- [ ] Conductors are allowing the electric current to flow. Non-conductors often enclose them to prevent danger for people.
- [ ] The substances for which the lamp goes on are called insulators.
- [ ] The substances for which the lamp does not light up are called conductors.
- [ ] The substances for which the lamp does not go on are called insulators.

Check



PHYWE

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37079 Göttingen

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info@phywe.de
www.phywe.de