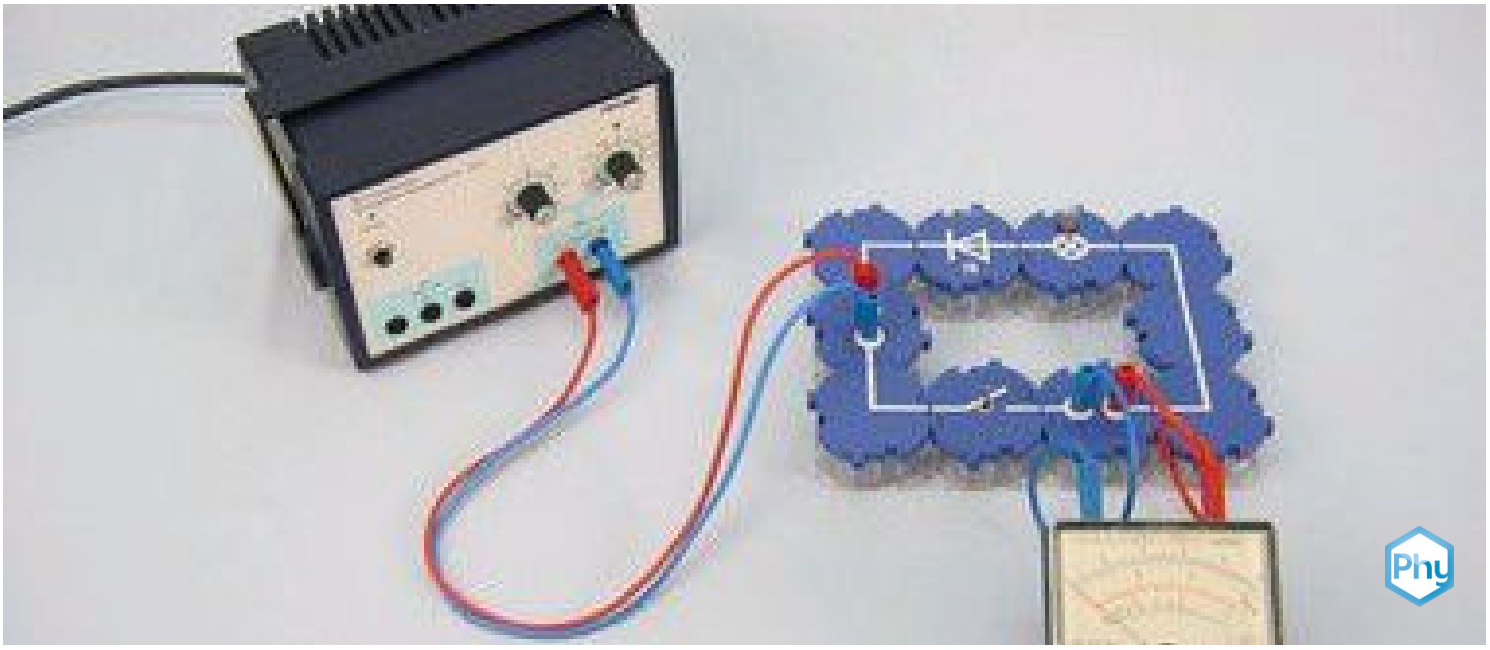
Diodes as electrical valves



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

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/6315a81c13aa4c0003fd2a7e

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Teacher information

Application

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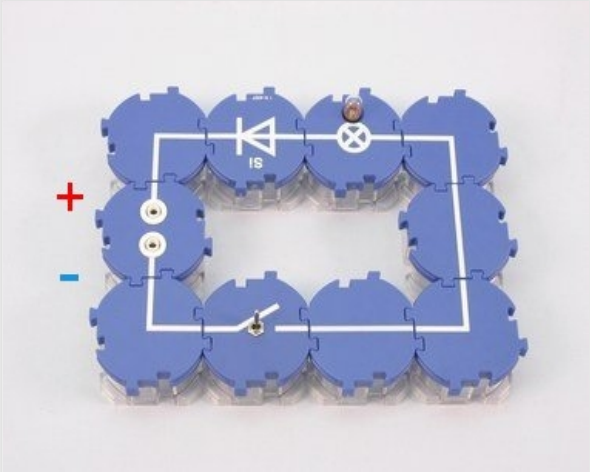

Experimental setup

Nowadays, diodes are used everywhere.

Most obviously as a light source in the form of light-emitting diodes. One of the special features of a diode is that it can be used to block current in a certain direction or, for example, to limit voltages so that a component cannot be destroyed by overvoltage. Diodes are also used to convert alternating voltage into direct voltage. This is referred to as rectification.

In this experiment, we are explicitly concerned with the most important property of the direction of passage.

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Other teacher information (1/2)

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Prior knowledge

The students should be able to build a simple electric circuit. They should also understand what voltage and current are.

Learning objective

The students should realise that a diode acts like an electric valve.

Note: The measurement of the current intensity is not necessary for the detection of the valve effect because the incandescent lamp indicates the electric current anyway and no reverse current can be detected under the given experimental conditions.

Other teacher information (2/2)

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Task

The students should investigate what happens when a diode is connected in series with an incandescent lamp in a DC circuit. First, the students should realise that the diode only allows one forward direction. Then they measure the current in the circuit and obtain an additional quantitative result.

Principle

The term diode is usually used for semiconductor diodes (usually silicon diodes) that primarily work with a p-n junction. The doped atoms are stationary and form a space charge as ions, whose electrostatic field keeps the two types of charge away from each other and thus prevents recombination. The diffusion voltage arises across the entire space charge zone. This can be compensated by an externally applied voltage - depending on the polarity - in which case the p-n junction becomes conductive, or amplified, in which case it remains blocked.

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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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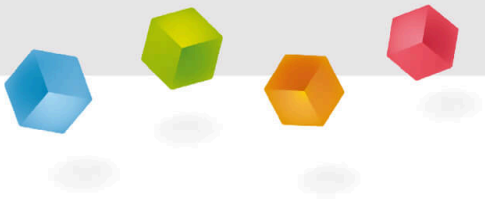

Student information

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Motivation

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LED lights of a headlight on a car

Semiconductor diodes are used in many ways in today's technology due to their useful properties. The light-emitting diode (LED) is particularly obvious in its application. Due to their efficiency, these are used, for example, in traffic lights, headlights, torches or as infrared light-emitting diodes in remote controls for signal transmission.

In this experiment, you will learn what properties a diode has, among other things.

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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	On-off switch module, SB	05602-01	1
5	Socket module for incandescent lamp E10, SB	05604-00	1
6	Silicon-diode module 1N4007, SB	05651-00	1
7	Connecting cord, 32 A, 250 mm, red	07360-01	1
8	Connecting cord, 32 A, 250 mm, blue	07360-04	1
9	Connecting cord, 32 A, 500 mm, red	07361-01	1
10	Connecting cord, 32 A, 500 mm, blue	07361-04	1
11	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
12	PHYWE Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	1
13	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up

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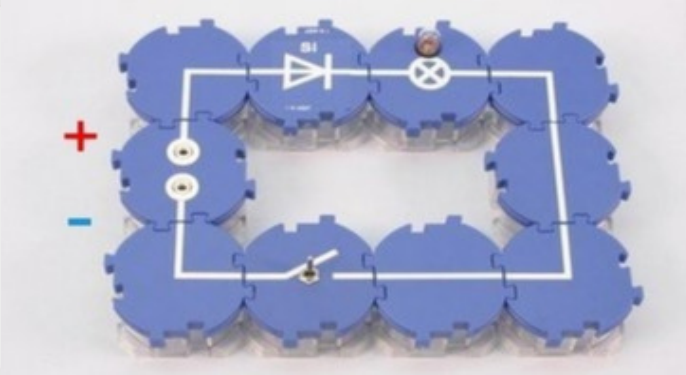
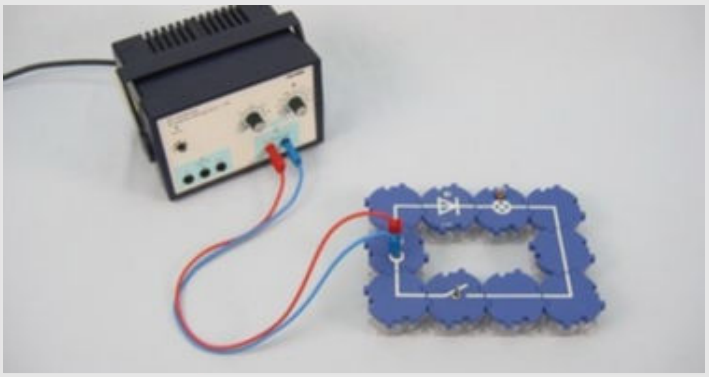
Set up the circuit as shown in the illustrations. The switch should be open at first. The tip of the diode in the printed circuit symbol points in the technical direction of the current (to the negative pole).





Procedure (1/2)

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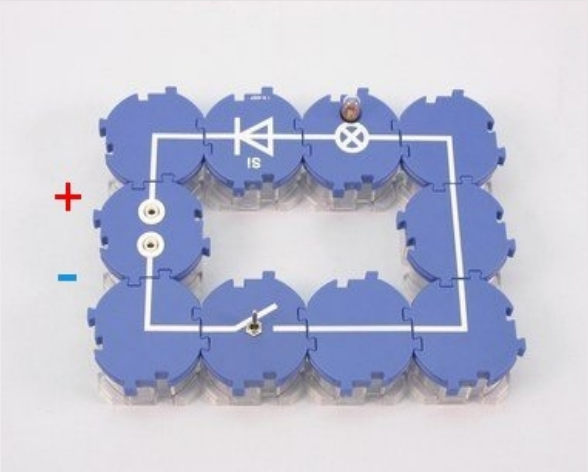

Experimental setup with rotated diode

- Switch on the power supply and set the power supply to a DC voltage of 12 V and the current limiter to 2 A (right stop).
- Close the switch and observe the bulb.
- Turn the diode 180° (see illustration) and observe the bulb while doing so.

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Procedure (2/2)

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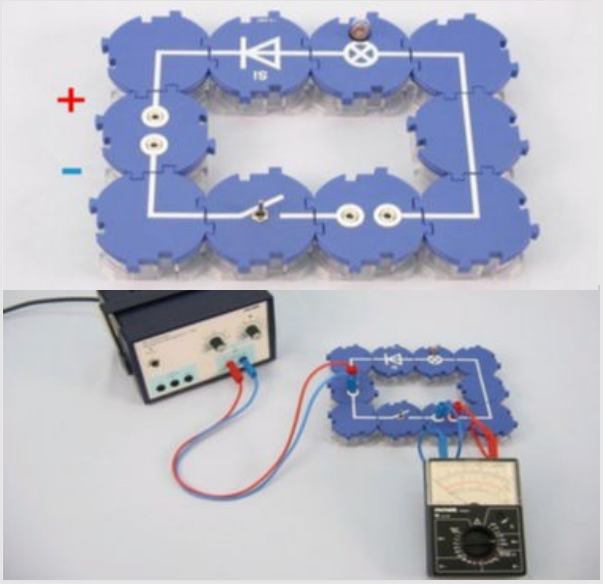

- Remove one of the line modules and replace it with a module with a double socket with a current meter (see illustrations).
- Always set a large measuring range first and, if necessary, adjust the respective measuring range down to the smallest current measuring range.
- Observe the current strength.
- Now set the largest measuring range again and turn the diode component back by 180°.
- Observe the current again.
- Switch off the power supply unit.

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Report

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Task 1

What observations could be made when carrying out the experiment?

After turning the diode, the bulb has ...

- ...continued to shine unchanged.
- ...no longer glowed.
- ...shone brighter.
- ...dimmed.

What is the relationship between the current strength and the experiment?

If the tip of the diode points to the positive pole...

- ...the current strength rises sharply.
- ...the current drops to zero.
- ...the current intensity does not change.

Task 1

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Task 2

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What can be concluded from the observations?

- ○ The diode generates a current in one direction opposite to the current source.
- ○ The diode only allows current to flow in one switching direction.

Check

Task 3

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What could the properties of a diode be used for? - Draw the correct word in the gap.

With a diode, you can block the _____ in a certain _____. This can be usefully employed in the _____ of _____ to _____. In this case, the diode only allows the current to flow in one direction (_____) and blocks it in the opposite polarity (_____).

DC voltage
direction
AC voltage
current
block direction
conversion
pass direction

Check

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