





# Operation of an LED with solar energy

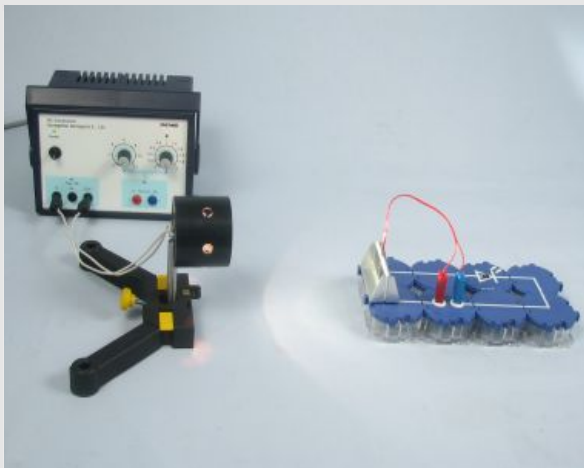


Physics	Energy	Energy forms, conversion & conservation	
Physics	Energy	Renewable energies: Sun	
 Difficulty level easy	 Group size 1	 Preparation time 10 minutes	 Execution time 10 minutes

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## General information

## Application

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Experiment setup

Solar energy can be converted into electrical energy with the help of a solar cell.

This is a very important form of energy, both in the home and in industry, as it can be easily converted into other forms of energy, such as heat, light or mechanical energy (motion).

## Other general information (1/3)

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### Previous knowledge



The students should have gained first experimental experience in using the student power supply.

### Principle



A red light emitting diode needs about 2 V- as supply voltage, so it cannot be operated with a single solar cell.

The equipment set contains a solar battery that supplies the required voltage. The purpose of this experiment is to illustrate how individual solar cells can be combined to produce the same voltage as from a solar battery: they are connected in series so that their voltages can add up. This principle is also used by the solar battery.

## Other teacher information (2/3)

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### Learning objective



This experiment teaches students the concept of converting solar energy into electrical energy. In the process, they must try to make an LED light up.

### Tasks



In the experiment, an LED is operated with a solar cell/solar battery.

Students illuminate a solar cell/solar battery and observe the LED connected to it.

## Other teacher information (3/3)

### Notes on structure and implementation

The experiment tries to operate the light emitting diode with one and two solar cells, which does not work. In the evaluation, the students should conclude that four solar cells must be connected in series in order to succeed.

This hypothesis can be tested in an additional experiment. To do this, two experimental groups must put their circuits together. One group must replace its light-emitting diode with a straight line component. The circuit is now aligned so that the longer side is illuminated by the halogen lamp.

If it is possible to carry out the experiment outdoors or near a window, the halogen lamp and the solar cell holders can be dispensed with. The light of the sun is then sufficient as an energy source.

## Safety instructions



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

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## Student Information

### Motivation

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Decorative solar lights

Solar cells can be used to convert the sun's light energy into electrical energy.

However, the amount of electricity generated must also be sufficient to operate electrical devices.

What everyday objects can be used well, powered only by solar cells?

## Tasks

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The experimental setup

Illuminate a solar cell and observe the LED connected to it.

## Equipment

Position	Material	Item No.	Quantity
1	<a href="#">Straight connector module, SB</a>	05601-01	2
2	<a href="#">Angled connector module, SB</a>	05601-02	4
3	<a href="#">Interrupted connector module with sockets, SB</a>	05601-04	2
4	<a href="#">Light emitting diode module red , SB</a>	05654-00	1
5	<a href="#">Solar cell 3.3 x 6.5 cm, with plugs, 0.5 V, 330 mA</a>	06752-09	2
6	<a href="#">Holder for solar cell 3.3 x 6.5 cm, with plugs</a>	06752-08	1
7	<a href="#">Solar battery, 4 cells, with cable and connectors</a>	06752-22	1
8	<a href="#">Measuring tape, l = 2 m</a>	09936-00	1
9	<a href="#">Connecting cord, 32 A, 250 mm, red</a>	07360-01	1
10	<a href="#">Connecting cord, 32 A, 250 mm, blue</a>	07360-04	1
11	<a href="#">Halogen lamp with reflector, 12V / 20W</a>	05780-00	1
12	<a href="#">Mount for halogen lamp with reflector</a>	05781-00	1
13	<a href="#">Support base, variable</a>	02001-00	1
14	<a href="#">Digital multimeter, 600V AC/DC, 10A AC/DC, 20 MΩ, 200 μF, 20 kHz, -20°C... 760°C</a>	07122-00	1
15	<a href="#">PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A</a>	13506-93	1

## Set-up

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1. Place the halogen lamp in one half of the stand base and connect it to the AC output of the power supply unit (12 V~) as shown in Figure 1. The power supply is switched off.
2. Build the circuit with the light emitting diode as shown in Fig. 2.
3. Align the circuit with the lamp as shown in Figure 3. The distance should be approx. 17 cm (Fig. 3).
4. Connect the solar battery to the circuit (Fig. 4).



Figure 1

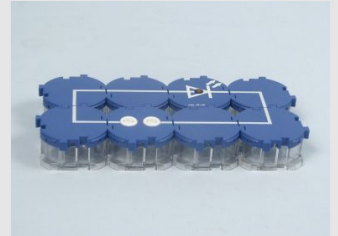


Figure 2

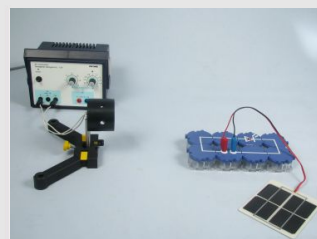


Figure 3

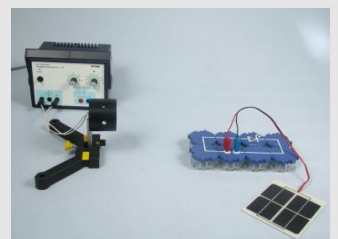


Figure 4

## Procedure (1/4)

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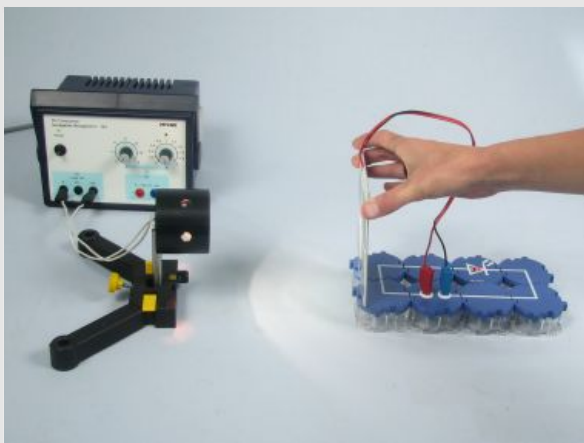


Figure 5

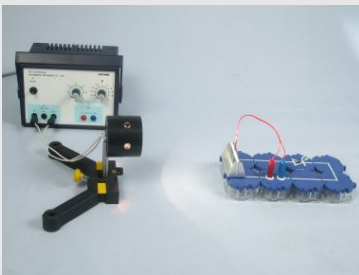
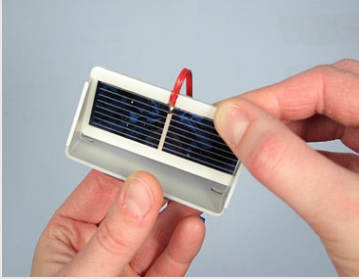
### Experiment 1

- Switch on the power supply unit. Place the solar battery on the bricks and hold it from behind.
- Align it so that it is illuminated centrally by the halogen lamp (Fig. 5).
- Is the light emitting diode lit up? Write down your observations.



## Procedure (2/4)

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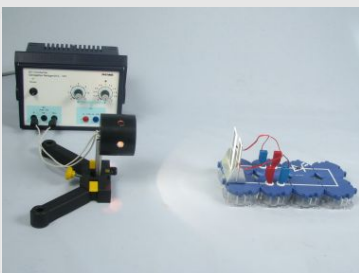


### Experiment 2

- Put the solar cell in its holder.
- Connect the solar cell instead of the solar battery and place it in the same location.
- Is the light emitting diode lit up? Write down your observations.

## Procedure (3/4)

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### Experiment 3

- Attach a second solar cell in the solar cell holder and connect them in series.
- Observe what happens when you light two solar cells and write down your observations.

## Procedure (4/4)

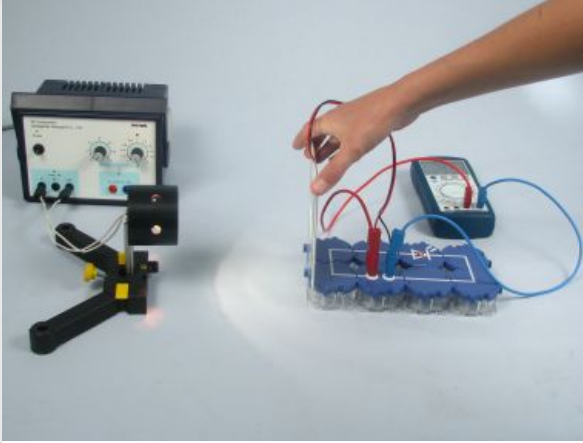
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Figure 6

### Experiment 4

- Connect the multimeter so that you can read the voltage of the solar battery.
- Set the measuring range to 20 volts DC (20 V-).
- Note the value for the voltage.
- Repeat the measurement for the two solar cells connected in series. Note down this value as well.

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## Report

## Task 1

What does the abbreviation LED stand for?

- Lightwave Equalizer-digital
- Low-energy diode
- Lightweight-electrical dispenser
- Light-emitting diode

✓ Check

## Task 2

A solar cell generates about 0.5V voltage.

What voltage is generated by three solar cells connected in series?

0.5V

0.75V

0.25V

1.5V

## Task 3

## Place the words in the correct gaps

All  require a minimum amount of voltage and  to function.

If you want to power them with , the corresponding circuit must produce enough.

If there is not enough voltage, more cells must be connected .

Analogously, to increase the amperage produced, more cells must be connected .

current

in series

in parallel

solar cells

electrical devices

 Check

Slide	Score/Total
Slide 17: LED	0/1
Slide 18: Voltage of a solar cell	0/1
Slide 19: Electrical devices	0/5

Total  0/7 Solutions Repeat