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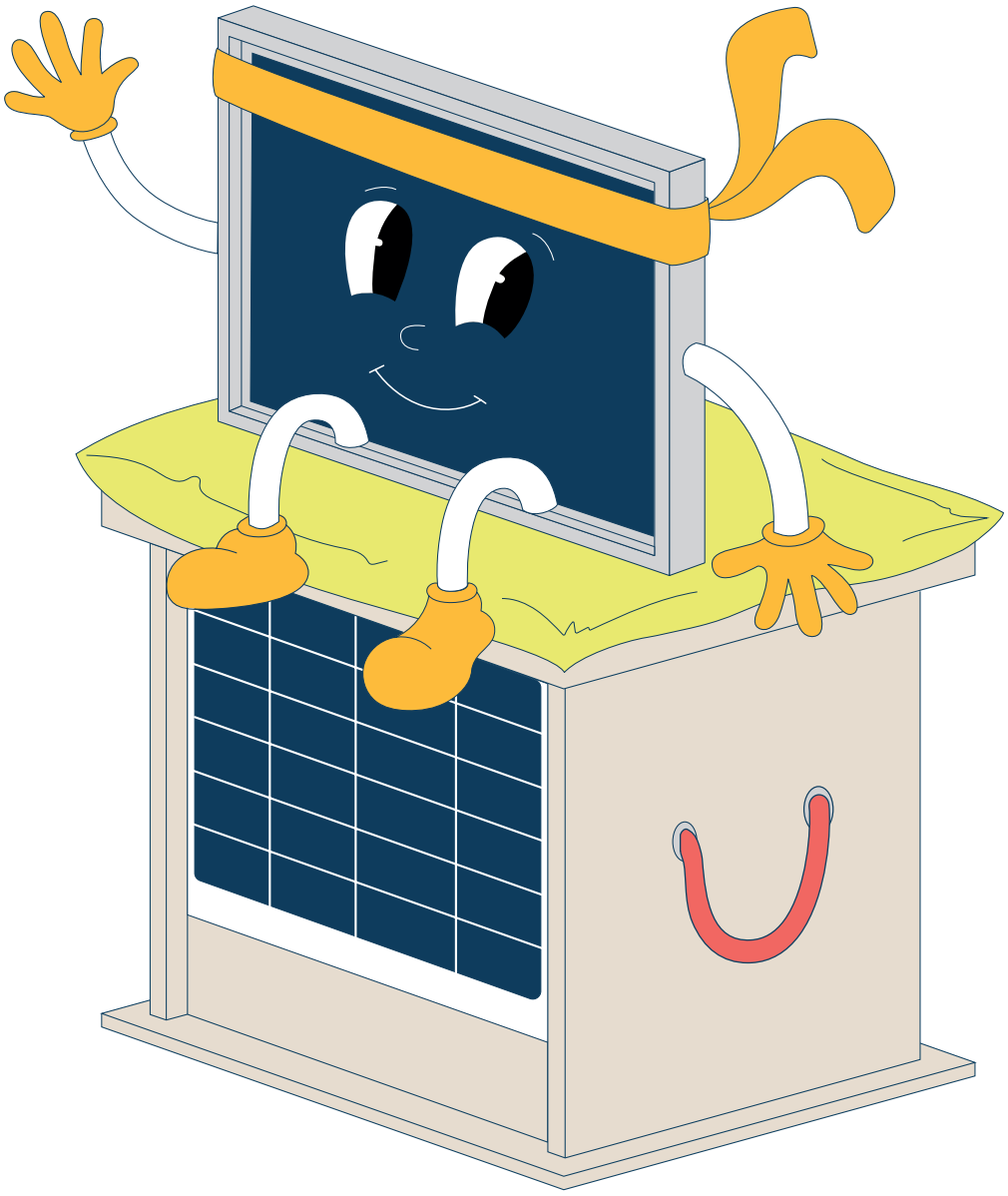

Teacher‘s script

Electric circuits & solar energy

in elementary school with the **electric cube**

Grade 3/4

Experiment kit

We always strive to check our lessons thoroughly for possible errors before publication. However, if you, dear user, notice something, we would be grateful if you could send us a message at fehlerteufel@solarbildung.org.

Electric cube designed by Lothar Leuchter (master electrician & master designer) Accompanying material created by Alexandra Müller (elementary school teacher)

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Teacher‘s script

Electric circuits & solar energy

in elementary school with the **electric cube**

Content

Info The Lesson

Summary

The teaching ideas for the sequence „Electric circuits and solar energy in elementary school with the electric cube“ can be assigned to ”Learning Area 3: Nature and Environment - 3.2. Materials and Energy.“

During these lessons, students will use the Electric Cube and the accompanying

research sheets to build and sketch various electrical circuits, investigate the conductivity of different substances, and learn about solar energy as a method of generating electricity. Thanks to the age-appropriate and contemporary design of the materials, the students can explore this topic in an action-oriented way and discover it for themselves.

The experiments on electrical circuits are included in quadruplicate and can be quickly and easily assigned to the appropriate experiments thanks to the colour coding of the individual modules.

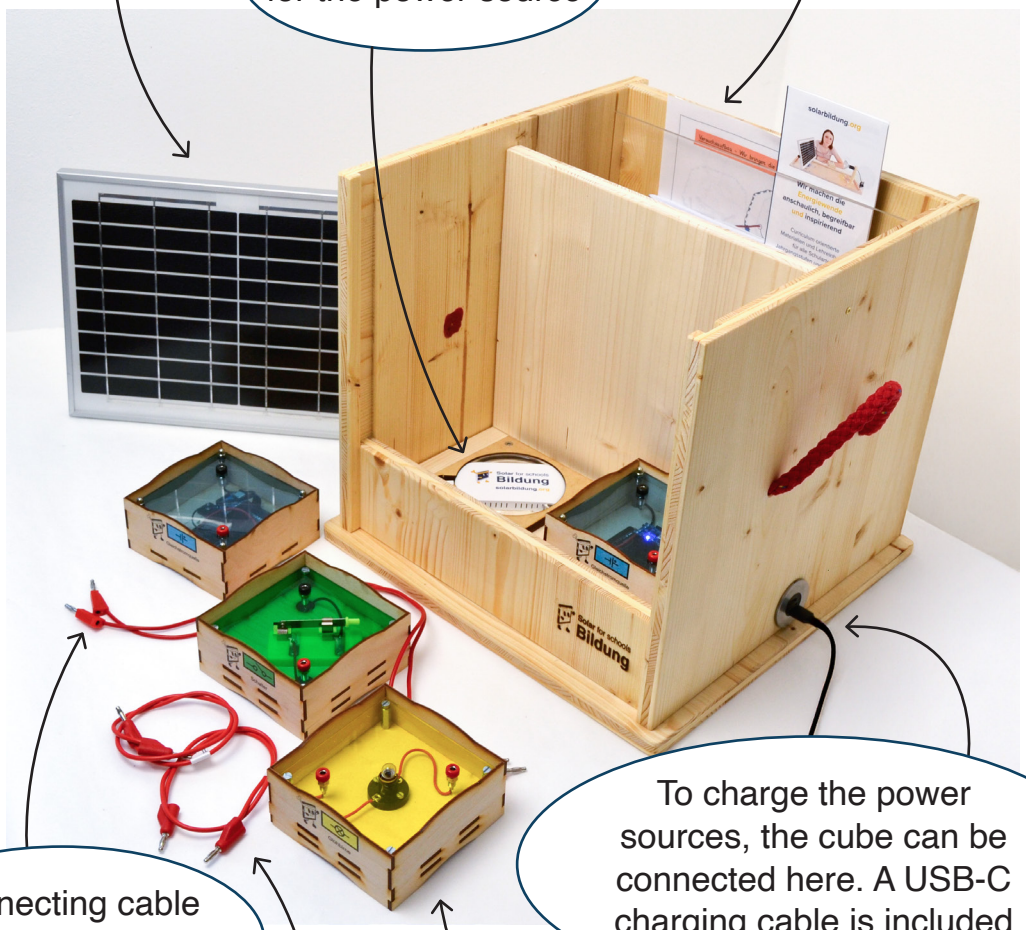
The transparent housings of the individual modules make the experiments particularly clear and increase the students‘ enthusiasm for experimenting. All utensils can be easily stored in the cube and can therefore be quickly set up and taken down. The practical cube stool, in which the experiments are stored, also fits visually into the students‘ learning environment as a piece of furniture.

Thanks to the cube‘s modern and wireless charging system, the researcher set can be used in class at any time and without researcher set can be used in class at any time without long lead times. The charging system can also be expanded with a photovoltaic module to enable students to experience different methods of power generation.

Contents of the accompanying material

1. The electric cube explained
2. Series transparency for teachers
3. Ready-made lesson plans
4. Materials and research sheets for the individual lessons

Info Structure “Electric cube”



Series transparency for teachers

Summary

The following content should have already been covered with the students before experimenting with the electric cube:

- What I know about electricity and what I would still like to know about electricity
- What is electricity? --> Additional material: FB 1 “We make electrical voltage visible”
- What effect does electricity have?
- Electricity rules

	Lesson Content	Required Materials
1	**We make the lamp light up** The students learn about the components of a light bulb and a battery, build a simple circuit, sketch it, and recognize that electrons can only flow in a closed loop.	Electric cube, FB 2, WK “Light bulb”, WK “Battery”, Research steps TK “Yellow module” TK “Light blue module”
2	**We install a switch** The students learn how to open and close an electric circuit in a targeted manner, build an electric circuit with a switch and sketch it.	Electric cube, FB 3, Research steps TK “yellow module” TK “green module” TK “light blue module”
3	**We light up two lamps** The students light two lamps using a series- and a parallel connection and recognize the respective advantages and disadvantages	Electric cube, FB 4, Research steps TK “yellow module” TK “green module” TK “light blue module”
4	**Which materials conduct electricity?** The students test various materials for their conductivity by incorporating them into the circuit.	Electric cube, FB 5, Research steps TK “yellow module” TK “light blue module” WK “Conductors & Non-conductors”
5	**Power generation through solar energy** The students learn about solar cells as an environmentally friendly source of energy and experiment with how to generate the most electricity from solar energy	Elektrowürfel, FB 6

The following content can be added **after the experiment**:

- Fossil fuel and renewable forms of power generation and their advantages and disadvantages
- Energy saving

01 We make the lamp light up

Lesson objective

The students learn about the components of a light bulb and a battery, build a simple circuit, sketch it, and recognize that electrons can only flow in a closed loop.

Experiment description

In this experiment, a battery module is used as a power source to light up a light bulb.

Materials needed

- 2 cables
- 1 light blue module (battery)
- 1 yellow module (light bulb)
- Research sheet FB 2
- Word cards for the light bulb and battery
  Tip cards for the yellow and light blue modules

Versuchsaufbau

Finding

Electrons can only move in a **closed circuit**. The movement of electrons generates **heat** and **light** in incandescent bulbs.

Schedule

Time	Phase	Course	Material
8 min	Inform	Students gather in cinema seating. The teacher shows them the light bulb. Students label the parts of the light bulb together using the word cards. The teacher places the yellow module with the light bulb next to it and shows the blue module. Students label the parts of the battery together using the word cards.	Incandescent lamp, WK “light bulb,” WK “battery,” yellow module, light blue module
3 min	Introduction	Teacher points questioningly at the two modules. Students name the lesson objective: **We will make the lamp light up.**	Yellow & light blue module
20 min	Development	The teacher works out the research steps together with the students and writes them on the board. 1. Make assumptions 2. Try things out 3. Record/note down results 4. Recognize Students work on the research sheet in groups **As differentiation for building the circuit**, the tip cards “blue box” and “yellow box” can be hung behind the board. **As differentiation for the cloze text**, the gap words can be written behind the board	Electric cube, FB 2, Research steps TK „Yellow module“, TK „Light blue module“
5 min	Fuse	Individual students present their results. Joint review of the circuit diagrams and findings.	completed FB 2
4 min	Reflexion	Joint reflection in a circle, using prompts such as: Today I learned ... Next time, I will try to ... What helped me was	

02 We are installing a switch

Lesson objective

Students learn how to open and close an electrical circuit in a targeted manner, build an electrical circuit with a switch, and sketch it.

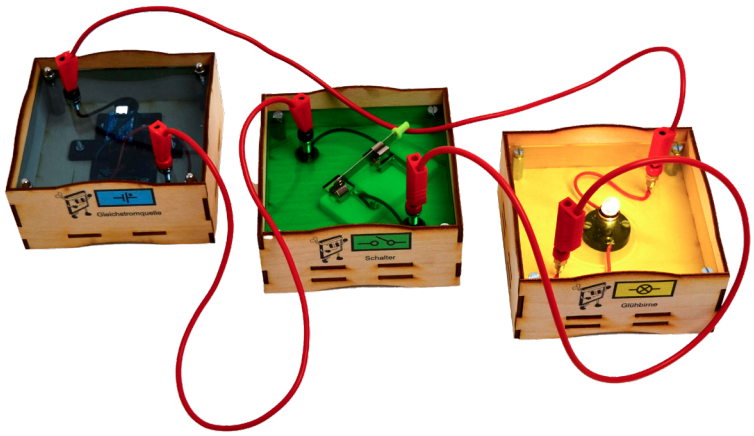
Experiment description

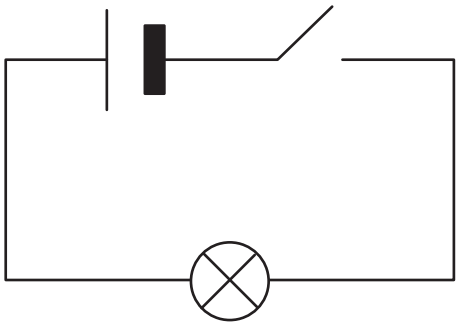
In these experiments, a light bulb is lit using a battery module as a power source and a switch.

Materials needed

- 3 cables
- 1 light blue module (battery)
- 1 yellow module (light bulb)
- 1 green module (switch)
- Research sheet FB 3
- Tip cards for the yellow, green, and light blue modules

Experimental setup





Finding

You can use the switch to **open** and **close** the circuit as desired.

The lamp is now **remote-controlled**.

Schedule

Time	Phase	Course	Material
5 min	Activate prior knowledge	Students get into cinema seating. LK shows the yellow and blue modules. Students repeat together how to make the light bulb glow and that the electrons must flow in a circle for the light bulb to glow.	Yellow and lightblue module
5 min	Introduction	Teacher shows the green module with the switch. Students describe it. Teacher shows the target flag and students formulate the lesson objective: **We are installing a light switch.**	green module
20 min	Development	Students repeat the research steps and hang them on the board in the correct order. Students work on the research sheet in groups. **To differentiate between the construction of the circuit,** the tip cards “blue module,” “yellow module,” and “green module” can be hung behind the board. **As a differentiation for the cloze text**, the missing words can be written behind the board.	Electric cube, FB 3, Research steps TK „yellow module“ TK „green module“ TK „light blue module“
10 min	Fuse	A couple of students present their results. Joint review of the circuit diagrams drawn and findings.	completed FB 3
5 min	Reflexion	Joint reflection in a circle, using the following prompts, for example: I learned today that … Next time, I will … What helped me was…	

03 We light up two lamps

Lesson objective

The students light up two lamps using a series and a parallel circuit and recognize the respective advantages and disadvantages

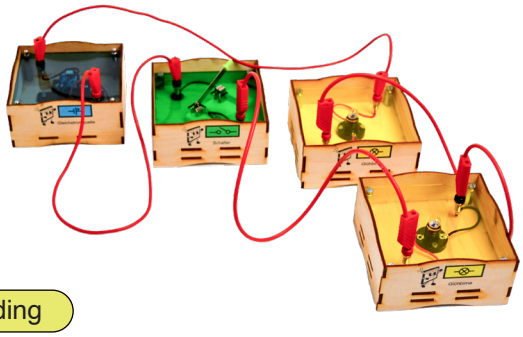
Experiment description

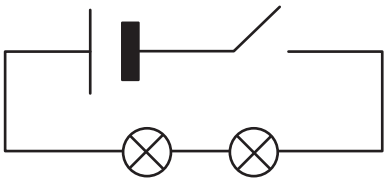
In these experiments, two light bulbs are made to light up using a battery module as a power source and a switch. In doing so, the pupils test and describe the effects of electrical energy in a series and a parallel circuit.

Materials needed

- 5 cables
- 1 light blue module (battery)
- 2 yellow modules (light bulb)
- 1 green module (switch)
- Researcher sheet FB 4
- Hint cards for the yellow, light blue and green module

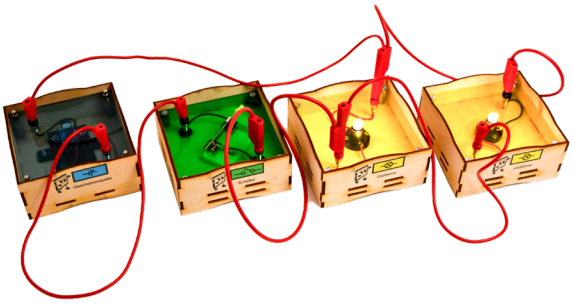
Experimental setup

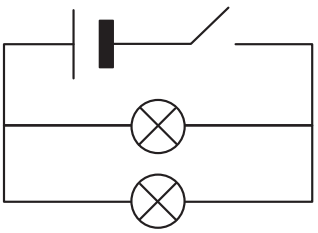




Finding

The two lamps are connected in **series**. They only shine **half as brightly**.



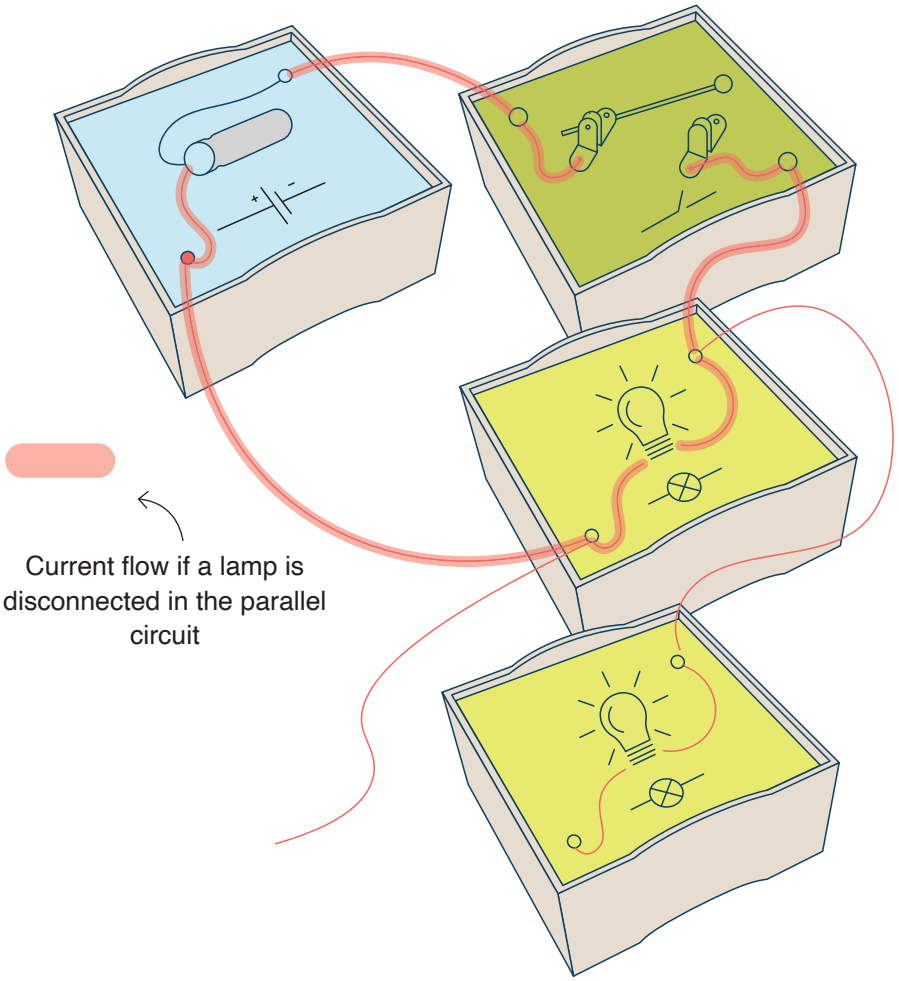


Finding

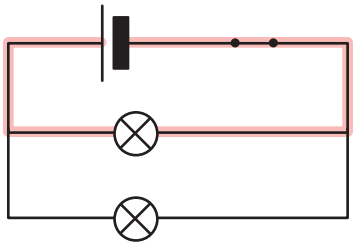
The two lamps are connected in **parallel**. They both shine **equally brightly**.

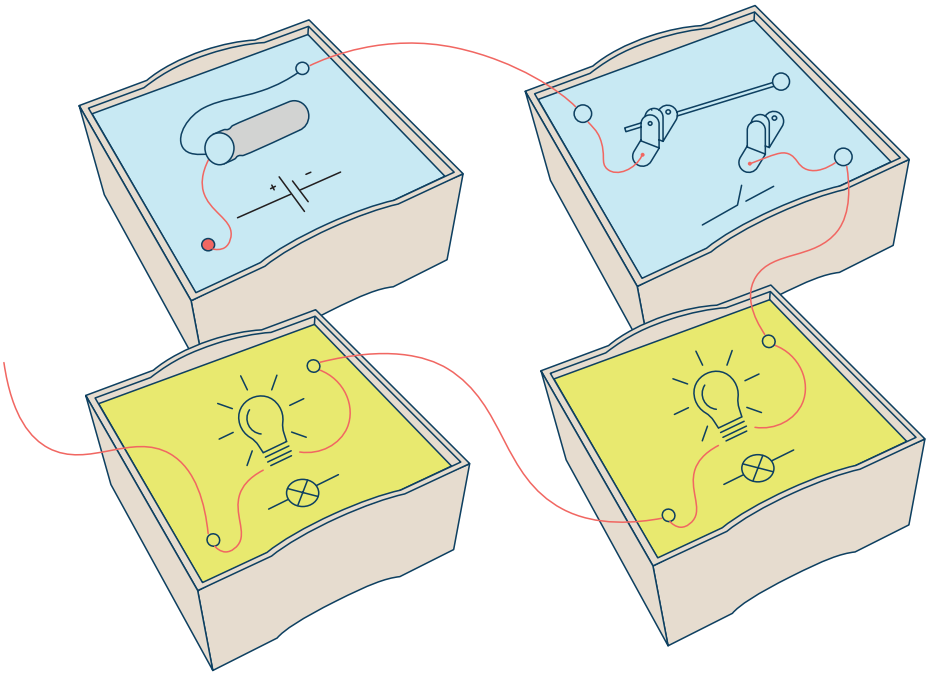
Schedule

Time	Phase	Course	Material
5 min	Activate prior knowledge	Pupils get into the cinema seat. Instructor shows yellow, light blue and green module. Pupils repeat together how to install aswitch and that it can be used to interrupt the circuit.	yellow, light blue and green module
5 min	Introduction	Teacher adds another yellow module. Teacher shows the target flag and pupils formulate the lesson objective: **We light up two lamps**	Second yellow module
30 min	Development	Pupils repeat the research steps and put them on the board in the correct order. Pupils work on the research sheet in groups. The hint cards “light blue module”, “yellow module” and “green module” can be hung behind the board to **differentiate the construction of the circuit.** **As a differentiation for the cloze text**, the cloze words can be written behind the board. **As a differentiation for the parallel circuit**, a finished circuit diagram of a parallel circuit can be drawn on the back of the board. The pupils then have to recreate this	Electric cube, FB 4, Research steps TK “yellow module” TK “green module” TK „light blue module
10 min	Fuse	Individual pupils present their results. Joint checking of the circuit diagrams drawn. Joint drawing of the paths of the electrons in the experimental setup when one lamp is disconnected at a time. (See picture under articulation) to explain why the lamp can continue to light up when connected in parallel.	Completed FB 4
5 min	Application	Teacher shows a string of lights (as an object or as a picture) with several lights and asks: „Imagine a light breaks. What happens to the string of lights when is switched on if the lights are connected in series? And what happens if the lights are connected in parallel?“ Using the knowledge gained in the lesson, pupils describe that the other lamps remain lit when connected in parallel and that all lamps remain dark when connected in series.	String of lights
5 min	Reflection	Joint reflection in a circle, using the following prompts, for example: I learned today that … Next time, I will … What helped me was…	

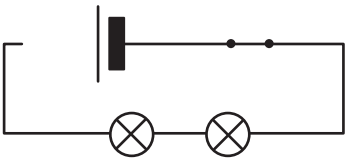


Current flow if a lamp is disconnected in the parallel circuit





The circuit is interrupted here and can no longer flow. So no lamp lights up.



04 Which materials conduct electricity?

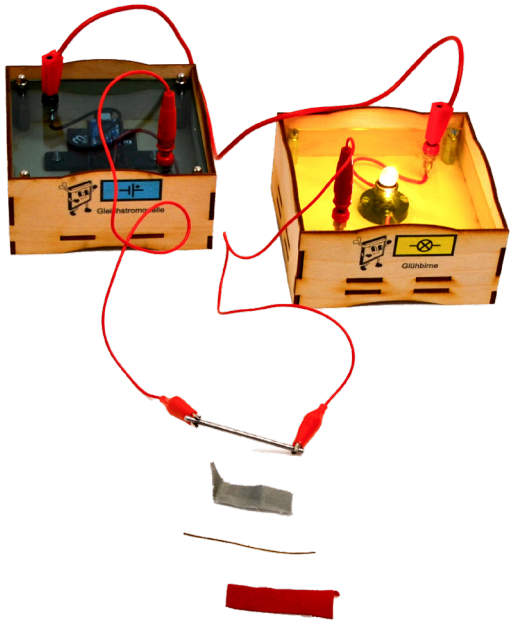
Lesson objective

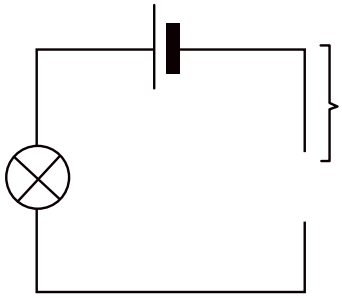
Students learn about solar cells as an environmentally friendly source of energy and experiment with how to generate the most electricity from solar energy.

Experiment description

In this lesson, students explore how to position the solar cell so that it generates the most electricity. They record their findings in a research sheet.

Experimental setup





Placeholder for the materials

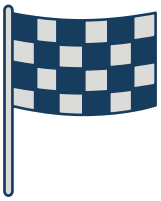
Materials needed

- 1 cable with plug
- 2 cables with crocodile clips
- 1 light blue module (battery)
- 1 yellow module (light bulb)
- Researcher sheet FB 5
- Tip cards for the yellow and light blue modules
- Various materials to be tested for conductivity. (Not included in the cube!)

Schedule

Time	Phase	Course	Material
5 min	Introduction	Pupils come into the circle. Instructor shows the yellow and blue module with the different cables. Pupils build an electric circuit and realize that there is a gap between the two clamps and that the circuit is interrupted. Instructor shows various materials in the bag. Pupils describe what they see and match the corresponding word cards. Instructor shows the target flag and pupils formulate the lesson objective: **We will find out which materials conduct electricity** or **We will find out which materials close the circuit.**	blue and yellow module, 1 cable with plug, 2 cables with crocodile clips, WK “conductor & non-conductor”
20 min	Elaboration	Pupils repeat the research steps and put them on the board in the correct order. Pupils work on the research sheet in groups. **As differentiation for building the circuit**, the hint cards “blue module”, “yellow module” can be hung behind the board. **As differentiation for the cloze text,** the cloze words can be written behind the board.	Electric cube, FB 5, Research steps TK “yellow module” TK “light blue module”
10 min	Fuse	Individual pupils introduce non-leaders and leaders and sort the word cards on the board. Teacher shows video on the question. Is water a conductor? https://www.youtube.com/watch?v=Rjeq2ch37L4 Pupils use the video to justify the electricity rule “Keep connected electrical appliances away from water”	Completed FB 5, WK “Ladder & Non-ladder”
5 min	Reflection	Joint reflection in a circle, using prompts such as: Today I learned ... Next time, I will ... What helped me was ...	

05 Discovering solar energy



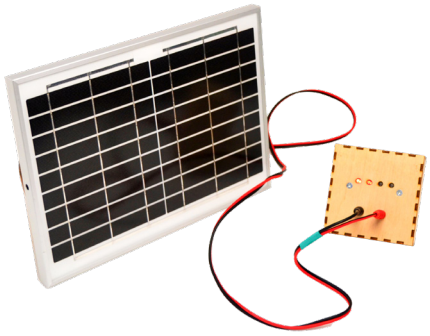
Lesson objective

Students learn about solar cells as an environmentally friendly source of energy and experiment with how to generate the most electricity from solar energy.

Experiment description

In this lesson, students explore how to position the solar cell so that it generates the most electricity. They record their findings in a research sheet.

Experimental setup



Material needed

- Solar cell
- Research sheet FB 6
- Module with 4 light-emitting diodes

Finding 2

What conclusions can you draw from the measurements?

The power panel generates the most energy when the light rays fall vertically on the solar cells. If no light hits the solar cells, no electricity is generated.

Finding 3

In addition to location, what environmental factors influence the amount of electricity generated?

Apart from the position of the panel, electricity generation in the environment depends on the time of day, the weather, shadows cast by trees, for example, and dirt.

Schedule

Time	Phase	Course	Material
5 min	Activate prior knowledge	Students gather in a circle. Teacher shows a solar panel. Students freely express their opinions about it. Teacher: „Have you ever seen a house with shiny panels on the roof or on the wall?“ Students share their previous experiences.	Solar panel
5 min	Informieren	LK briefly explains the basics: „Solar cells are little magicians. They capture the light from the sun (because the sun is the strongest source of light we know) and turn it into electricity, which we in turn can use to power lights or motors. IMPORTANT: To do this, the small cells ONLY need the sun and no other energy sources.“ „We can test whether this really works with our little lamp.“ Students use the knowledge they gained in the last few lessons to connect the green module to the solar cell. Students describe what they observe. „You probably have an idea of what the number of small lights might mean?“ Students express their guesses. --> The number of lights indicates how much electricity is being generated.	Solar panel, green module
5 min	Hinführung	LK moves the solar cell (tilting it, turning it to the left and right). Students describe what they can observe on the display. The teacher shrugs his shoulders and shows the target flag. Students name the lesson objective: **How can a solar cell generate the most electricity?**	Solar panel, green module
15 min	Erarbeitung	The students attach the research steps to the board in the correct order. “As a guess, you should draw different positions of the solar panel today and guess whether a lot or a little electricity can be generated there. Then we will try them out and you will record your measurements.” Alternatively, the differentiated research sheet with positions already marked can be filled out. After making their guesses, the Stundents try out the different positions in class and record the measurement results in their research sheets. The Students then collect the findings they have gained from their exploration in GA and record them on the research sheet.	completed FB 4

10 min	Fuse	Individual SoS present their results. LK „You probably have an idea which factors in nature, apart from the position of the solar panel, also influence power generation.“ --> Think, Pair, Share Collect and record the environmental factors found (e.g. clouds, night, shadows, earth movement) on the research sheet.	completed FB 6.1. or 6.2.
5 min	Thinking ahead	Students gather in a circle. „You want to convince your parents to install a solar power system in the garden or on the balcony. What reasons can you think of for doing so?“ Collecting advantages together: - The sun shines for everyone - The sun is free - The sun comes back every day (it is renewable)