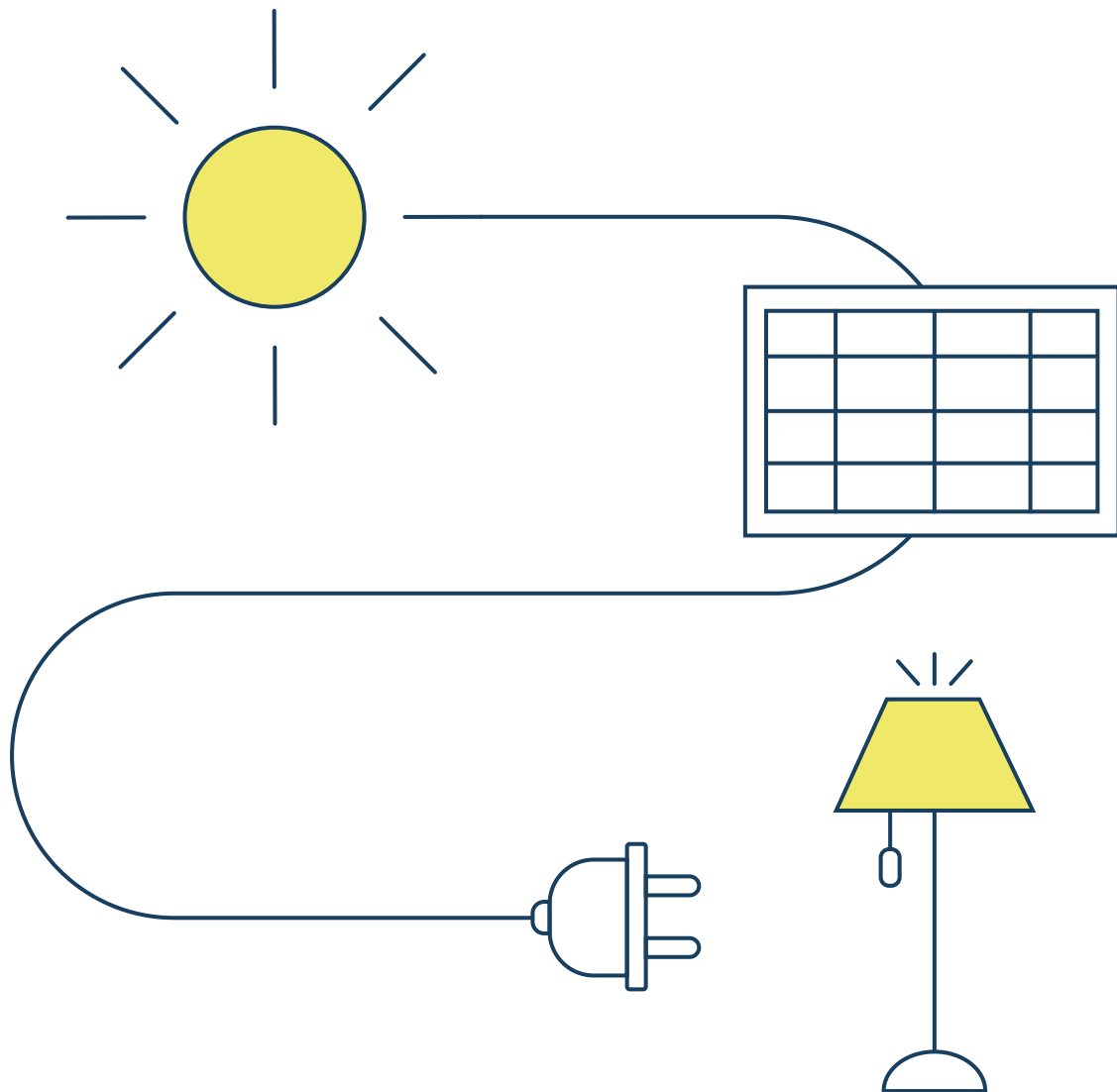


Explorer kit – Module 2: “Clouds are gathering”



Module 2: “Clouds are gathering”

The PV module under a cloudy sky

Topic:	Solar energy
Year:	From year 2
Curriculum reference:	Science, nature and environment, energy, weather
Duration:	20-45 minutes (customisable)
Summary:	The PV module under a cloudy sky is based on module 1. It is therefore advisable to complete Module 1 first. Module 2 focusses on how a PV module works when the sky is cloudy. The students learn that electricity can be produced by a PV system even in such weather conditions. A cloudy sky can be simulated using different cloud densities and the students can observe that different amounts of electricity are produced depending on the cloud density. This is visualised using a small propeller and / or LED light(s) connected to the PV module. The speed of the propeller or the number of lit LED lights provide information about the current intensity.

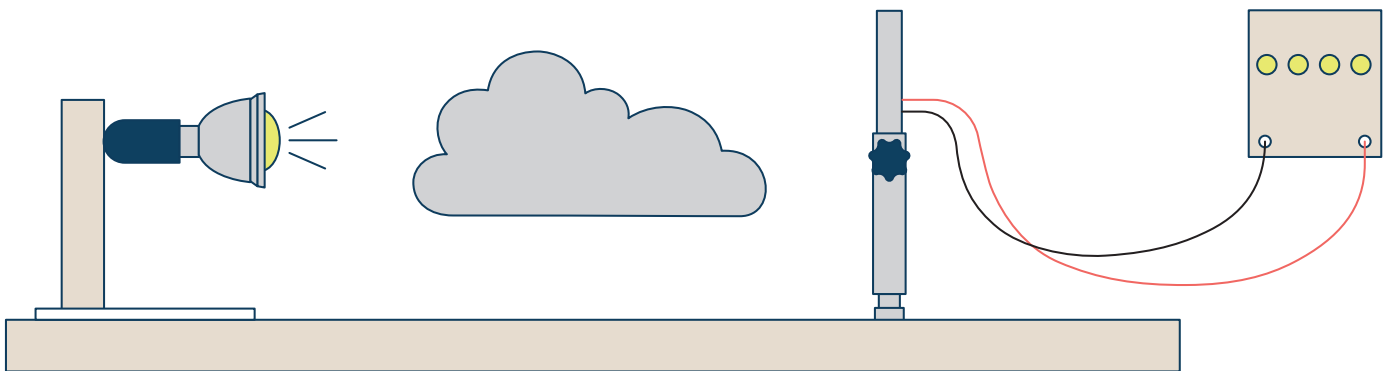
Learning goals:

- The students describe their previous knowledge of the educational game by repeating what they learnt in Module 1.
- The students experience that the PV module can produce electricity from sunlight even when it is cloudy by simulating the LED lights in cloudy weather together with the teacher using sunlight and verbalising their observations.
- The students understand that the PV module can produce different amounts of electricity depending on the cloud density by observing that more or fewer LED lights light up depending on the cloud density.
- The students reflect on their newly acquired knowledge by repeating it orally in class discussions or by recording it in writing/pictures.
- The students can experiment and gain experience themselves.

Preparation by the teacher:

The cloud replicas are supplied in the form of three pieces of paper of different densities. If desired, these can be cut out in cloud form in advance. This can also be done together with the students in preparation for the module.

Base plate with PV module, LED sun lamp, small LED lamp



Lesson plan

1. Start and activate prior knowledge: The teacher shows the students the learning game that has been set up. Together, the students and the teacher repeat the names of the individual parts (sun lamp, PV module and LED lamps) and repeat what they have learnt from Module 1. At this point, the experiment from Module 1 can also be briefly repeated. This can be decided depending on how long-ago Module 1 was carried out and how much of what has been learnt is still present.
2. Inform: Based on the repetition of Module 1, the teacher leads on to today's topic: Clouds are gathering - The PV module in cloudy skies. The transition could look like this: "What actually happens when there are clouds covering the sun? Can the PV module then also produce electricity? That's what we're going to find out today." At this point, the teacher can ask the students to make assumptions. The teacher then demonstrates the educational game.

The teacher can decide whether to use just one cloud replica or all the different dense cloud replicas. If they only use one cloud replica, they can make it visible to the students that the sun's rays pass through the cloud, hit the PV module and the PV module can convert the sunlight into electricity and thus produce electricity.

If they use all the cloud replicas one after the other, they can make it visible to the students that, depending on the cloud density, different amounts of sunlight pass through the cloud and hit the PV module. This means that the PV module produces different amounts of electricity depending on the cloud density.

These variants can be chosen individually depending on the time available, the grade's level and the students' understanding and interest.

The teacher conducts the learning game as follows: The sun rises (teacher switches on the sun lamp) and now shines. The LED lights visibly light up red. Now a cloud moves in front of the sun (the teacher holds a cloud between the sun lamp and the PV module). Fewer LED lights light up. The cloud disappears again (teacher takes the cloud away). All LED lights light up again. This can be repeated several times.

The pupils observe the experiment and verbalise their observations. Together with the teacher, they make assumptions about what they have observed and develop the following target conclusion: The sun's rays pass through the cloud and hit the PV module. This converts the sunlight into electricity. The electricity powers the LED lights and they light up. Even if there is a cloud between the sun and the PV module, enough sunlight passes through the cloud to the PV module. However, there are 'fewer rays' than without clouds, which is why fewer LED lamps light up.

The teacher can support this process with impulse questions or by repeating the learning game step by step. Optionally, the teacher can carry out the experiment again with the cloud parts of different densities. It is recommended that they start with the most permeable part and finish with the densest part. Depending on the cloud density, more or fewer LED lights will light up. Together with the teacher, the pupils make assumptions and work out the following target conclusion: Depending on how dense the clouds are, more or less sunlight passes through the cloud and hits the PV module. If there is a "thick cloud" in front of the sun, less sunlight passes through the cloud onto the PV module. The PV module "has less sunlight" that it can convert into electricity. Therefore, the LED lights receive less power, the power is "not enough" for all the lights and only one lights up. If there is a "thinner" cloud in front of the sun, more sunlight passes through the cloud onto the PV module. The PV module "has more sunlight", which it can convert into electricity. Therefore, the LED lights receive more current, the current is "enough" for more lights and two / three light up.

3. Processing and reflecting: There are various ways to process and reflect on what you have learnt. These can of course be combined.

Option 1: The students and the teacher repeat what they have learnt orally by carrying out the experiment again and accompanying it verbally.

Option 2: The students and the teacher work together to create a model sketch on the board and explain the individual parts and the experiment.

Option 3: The students work together on a worksheet for module 2. The teacher uses the enclosed graphics to create a worksheet. These can be found in the document "Explorer kit worksheet – Module 2". The teacher can select the graphics and add text, blank lines etc. depending on the year level and requirements. In the simplest case, the students can also just colour in the LED lights: If the sun is shining and there are no clouds in front of it, the students colour in all the LED lights; if there are clouds in front of the sun, they colour in fewer LED lights, depending on the density of the clouds.

Option 4: The students carry out the experiments previously presented by the teacher one by one independently, so that each student has the opportunity to experiment and gain experience.

Lesson phase	Content and Activities	Media Materials and	Suggested timing
Get started and activate prior knowledge	<p>Impulse educational game</p> <p>Students and instructor name the individual parts of the learning game and repeat what they have learnt from Module 1.</p> <p>They may carry out the experiment from Module 1 again.</p>	Educational game	5 min
Inform	<p>Realisation of the educational game:</p> <p>with LED lights</p> <p>Setting up the educational game on the desk</p> <p>Teacher shows the cloud replica and names it.</p> <p>Optional: Students make assumptions about how the PV module works under a cloudy sky</p> <p>Teacher demonstrates the educational game</p> <p>Pupils observe and verbalise their observations</p> <p>Students make assumptions about what they have observed.</p> <p>Target conclusions: Electricity is produced by a PV module even when the sky is cloudy. The current strength depends on the cloud density.</p>	<p>Educational game</p> <p>Model clouds</p>	10-30 min
Process and reflect	<p>Option 1:</p> <p>Students and teacher repeat what they have learnt orally by carrying out the experiment again and accompanying it verbally</p> <p>Option 2: Model sketch on the blackboard</p> <p>Option 3: Worksheet</p> <p>Option 4: Pupils experiment on their own</p>	<p>Educational game</p> <p>Blackboard</p> <p>Worksheet</p>	<p>5 min</p> <p>10 min</p> <p>5-10 min</p>