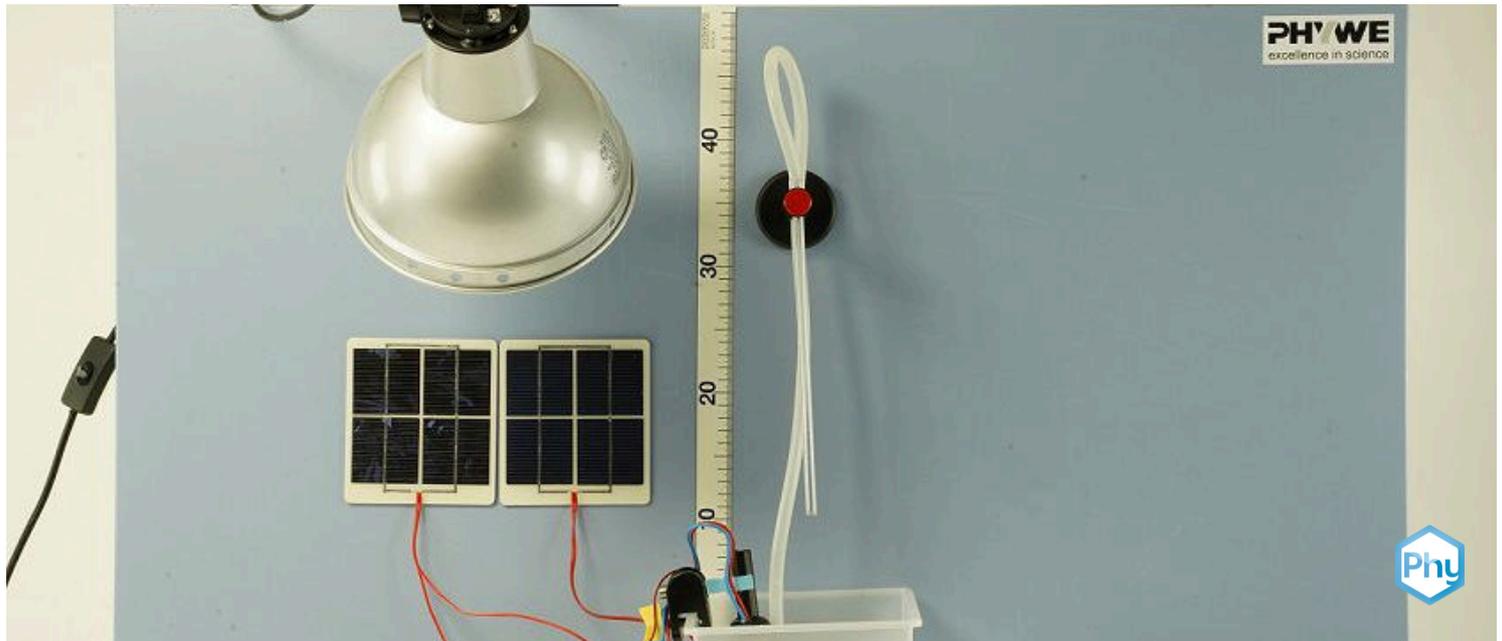


Pumping water with solar energy



Pumping water with solar energy

Physics

Energy

Renewable energies: Sun



Difficulty level

medium



Group size

-



Preparation time

10 minutes



Execution time

20 minutes

This content can also be found online at:



<http://localhost:1337/c/64a6be2a1103d300028e0184>

PHYWE



General information

Application

PHYWE



Pumping water with solar energy

Pumped storage power plants are used to balance out fluctuations in electricity demand. For this to work, water must be regularly pumped into higher basins.

The use of renewable energies such as solar energy increases the fluctuations in the difference between electricity demand and feed-in. Water storage is an important element for balancing these fluctuations.

Other information (1/2)

PHYWE

Prior knowledge



The basics of measuring current and voltage as well as determining energy and power from these measurands should be known.

The performance of the solar cell decreases when it is very hot. The lamp must therefore be switched off immediately after each experiment.

Principle



This experiment investigates how high water can be pumped with one or two solar batteries.

If water is pumped upwards, then the potential energy increases, which can easily be converted into other forms of energy, e.g. electrical energy, if required.

Other information (2/2)

PHYWE

Note



The students recognise how a pump can be powered by one or two solar batteries.

For this purpose, the voltage ratio of one to two solar batteries is seen with the rising height of the water.

Task



There must be no air in the pump, as this reduces the pumping capacity.

It is advisable to use distilled water to avoid limescale residues that can later cause e.g. jamming of the impeller.

Safety instructions

PHYWE

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

For H and P phrases, please refer to the safety data sheet of the respective chemical.

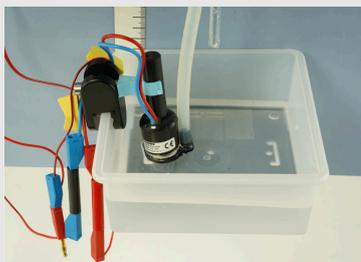
Theory

PHYWE



Theory of a solar cell

The solar cell plays an important role in the development of alternative, non-fossil energy sources. It directly converts light energy into electrical energy.



Theory of a water pump

A water pump is a device for pumping and moving water. Different types of pumps are used, each of which is adapted to the physical properties of the medium.

Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	Solar battery, with cable, connectors and magnet pads	06752-23	2
3	Clamping holder with 2 clamping possibilities, 0-13 mm, fixing magnet	02151-08	1
4	Scale for demonstration board	02153-00	1
5	Clamp on holder	02164-00	1
6	Apparatus carrier w. fix. magnet	45525-00	1
7	Beaker, Borosilicate, low-form, 400 ml	46055-00	1
8	Silicone tubing, ID 6 mm	47530-00	1
9	Boss head	02043-00	1
10	Double sockets, 1 pair, red and black	07264-00	1
11	Clamp, d = 16 mm, with mounting rod	05764-00	1
12	Water pump/ water turbine/ generator	05753-00	1
13	Dish, plastic, 150x150x65 mm	33928-00	1
14	Glass tubes, l. 250 mm, pkg. of 10	MAU-16074544	1
15	Snap-fastener, flexible	170863	1
16	Support rod, stainless steel, 750 mm	02033-00	1
17	Ceramic lamp socket E27, with reflector, switch and security plug	06751-01	1
18	Filament lamp, 220V/120W, with reflector	06759-93	1
19	G-clamp	02014-01	2

PHYWE



Setup and procedure

Setup (1/3)

PHYWE



- Position the clamp on the upper edge of the board above the solar battery on the support and screw it down carefully.
- Attach the support rod with the lamp in it and align it with the solar battery.
- The distance between the centre of the solar battery and the front of the lamp should be approx. 35 cm.
- The lamp is switched off.

Setup (2/3)

PHYWE
excellence in science

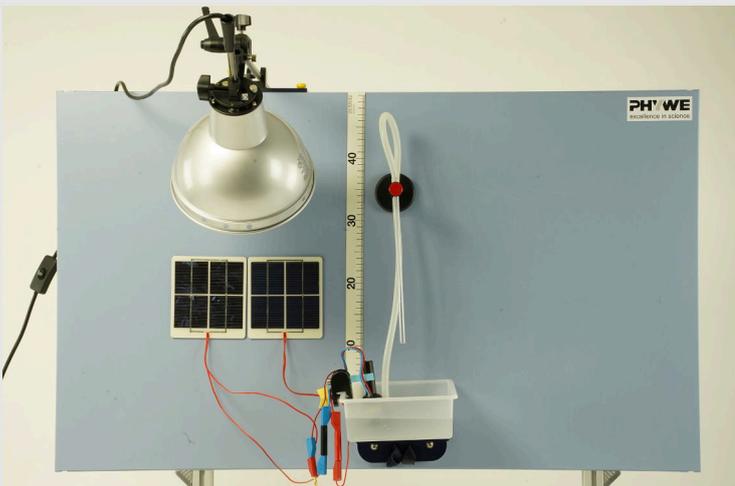


Experiment setup with a solar battery

- Set up the circuit according to the illustration.
- Attach the device holder to the adhesive board with the underside facing upwards and place the tray.
- Fill the dish halfway with water.
- Attach the silicone tubing to the pump and guide it into the dish over the magnetic clamping holder.
- Place the pump in the dish with the help of the clamp holder.

Setup (3/3)

PHYWE

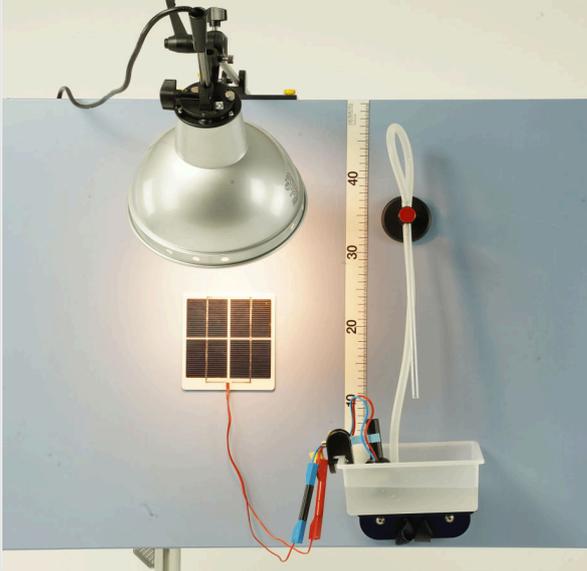


Setup with 2 solar cells

- Pass the glass tube through the second opening of the clamp holder and connect it to the silicone tube.
- Make sure that the end of the glass tube is above the dish.
- Set a scale perpendicular to the water surface, with the zero position at the level of the water surface.

Procedure (1/3)

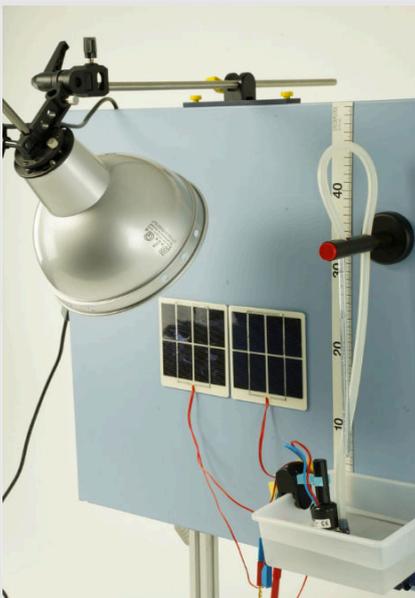
PHYWE
excellence in science



- Point the lamp with the solar battery and switch on.
- Observe the pump and the tube.
- Measure the height of the water column in the silicone hose.
- Switch off the lamp.
- Connect the second solar battery in series with the first.

Procedure (2/3)

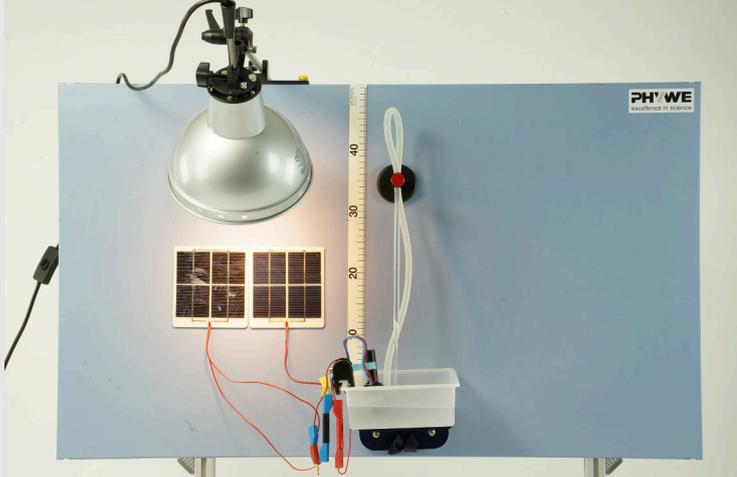
PHYWE
excellence in science



- Check the position of the tube above the dish.
- Align the lamp so that the solar batteries are not in the light cone and switch on.
- Vary the height of the climb by pushing it back and forth.
- Observe the pump and the tube.

Procedure (3/3)

PHYWE



Procedure - light cone via solar battery

- Move the light cone over the solar batteries in small steps and repeat the measurement.
- If a rise height of 40 cm is exceeded, the test must be terminated as the maximum voltage of the pump is exceeded.
- Switch off the lamp.

Evaluation

PHYWE
excellence in science

Observation

In both parts of the experiment, the motor runs and water is pumped up. With only one solar battery, you reach a height of about 15 cm.

With two solar batteries, the water column rises steadily the further the light cone is swivelled over the solar batteries until the pump height rises above 40 cm and the experiment has to be stopped.



Evaluation

With only one solar battery, a voltage of slightly more than is generated. The pump therefore only runs at low power and the water only rises about on average. Only with two solar batteries can a voltage of so that the rise reaches about .

Slide

Score / Total

Slide 15: Tension and climb height

0/4

Total score



 Show solutions

 Repeat