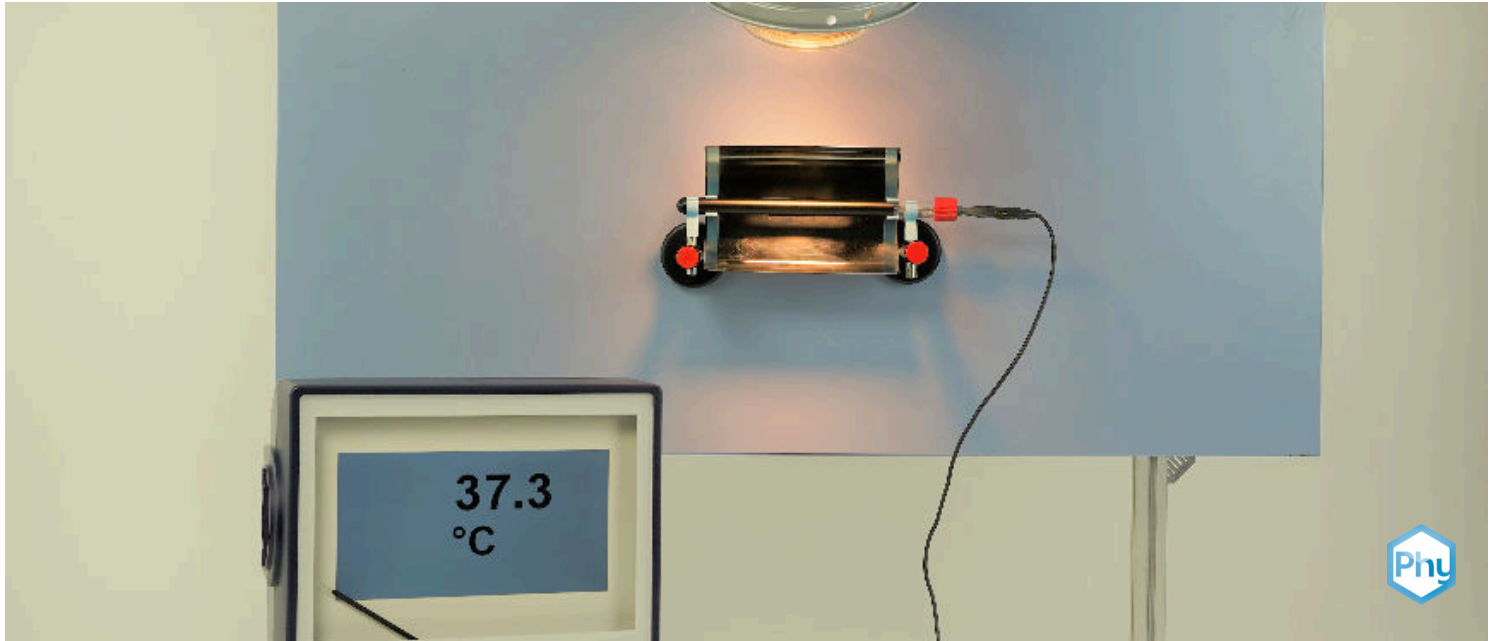


# Model of a field of a parabolic troughs



Model of a parabolic trough field

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:



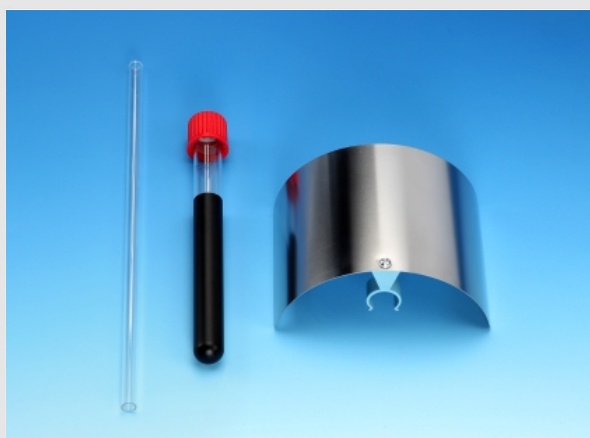
<http://localhost:1337/c/64a55b8582c76400021b5be3>

PHYWE

## General information



## Application

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Parabolic trough unit

### Model of a parabolic trough field

From the experiment "Heating water with a parabolic trough" it is already known that the absorption and thus the heating of the water strongly depends on the focal line.

In this experiment, the set-up of the parabolic trough field is not changed and instead a longer measured value recording is carried out. With a water quantity of 4 ml, it is achieved that the experiment runs relatively quickly.

## Other information

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### Prior knowledge



The basic concepts of thermodynamics should be known for this experiment.

### Principle



Parabolic mirrors concentrate the light of the sun in a focal point. Parabolic troughs, on the other hand, have a focal line in which tubes, for example, are heated very effectively.

The possibility of generating high temperatures and choosing a suitable fluid gives the pupils an impression of how a parabolic trough power plant works.

## Safety instructions

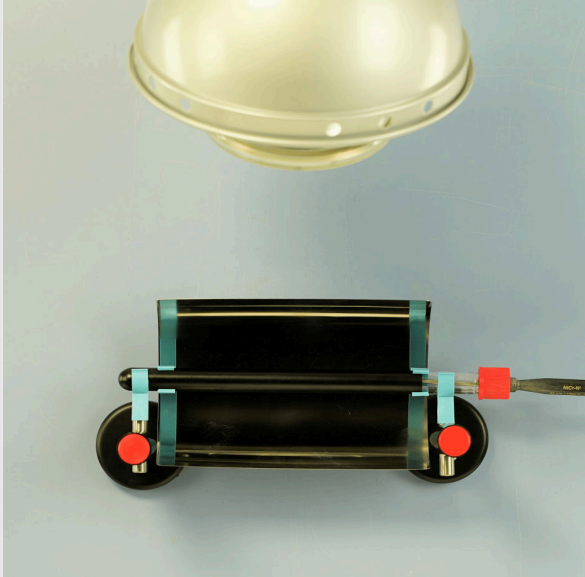
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The general instructions for safe experimentation in science lessons apply to this experiment.

Be careful, the concentration of the light makes the test tube very hot!

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

## Theory

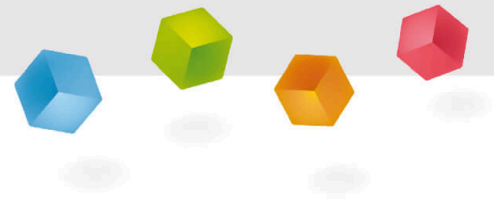


- Parabolic troughs collect the sunlight and concentrate it on a focal line.
- There is an absorber tube on the focal line.
- In this pipe, the medium can be heated to a very high temperature.
- The steam obtained from the process can be used to generate electricity.

## Equipment

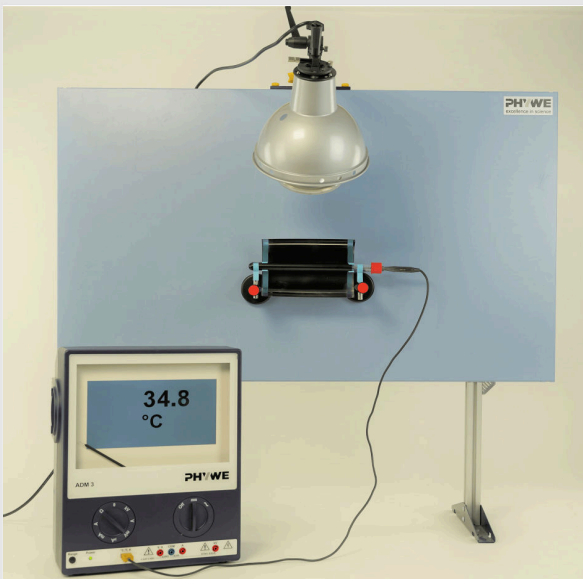
Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	PHYWE Demo Multimeter ADM 3: current, voltage, resistance, temperature	13840-00	1
3	Immersion probe NiCr-Ni, steel, -50...400 °C	13615-03	1
4	Clamping holder with 2 clamping possibilit, 0-13 mm,fixing magnet	02151-08	2
5	Clamp on holder	02164-00	1
6	Concentrated solar power unit, 180 mm	02168-00	1
7	clamp, d = 16 mm, with mounting rod	05764-00	2
8	Beaker, Borosilicate, low-form, 400 ml	46055-00	1
9	Syringe 20ml, Luer, 100 pcs	02591-10	1
10	Support rod, stainless steel, 750 mm	02033-00	1
11	Ceramic lamp socket E27, with reflector, switch and security plug	06751-01	1
12	Filament lamp, 220V/120W, with reflector	06759-93	1
13	G-clamp	02014-01	2

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## Setup and procedure

### Setup (1/2)

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- Fix the clamping holder with 2 clamping points at a distance of about 21 cm and insert the clamps.
- Fill 4 ml of water into the test tube using the syringe, then put on the screw cap with seal and screw it down slightly. Insert the glass tube so that it protrudes 2 cm from the cap. Then tighten the screw cap.
- Attach the mirror to the test tube and insert the test tube into the clamps using the clamps with mounting rod
- Insert the immersion probe into the tube.

## Setup (2/2)

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- Carefully clamp the sleeve to the upper edge of the demo board and fix the support rod in it. Hold the reflector lamp at the end of the support rod.
- Align the reflector lamp centrally on the test tube, the distance to the test tube should be approx. 28 cm.
- Adjust the mirror of the parabolic trough as parallel as possible to the incident light.



Experiment setup

## Procedure



- Switch on the lamp. Note the initial temperature in the evaluation.
- During the experiment, observe whether and where condensation occurs.
- Enter a measured value in the chart every 2 minutes.
- After 20 minutes, switch off the lamp and stop taking readings.
- Allow the test tube to cool, remove from the holders and remove the parabolic trough. Pour out the water from the test tube.

## Evaluation (1/2)

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Enter the measured values here!



Initial temp. 2 minutes 4 minutes

--	--	--

6 minutes 8 minutes 10 minutes

--	--	--

12 minutes 14 minutes 16 minutes

--	--	--

18 minutes Final temperature

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The water temperature rises to 80°C within about 8 minutes.

☐ True

☐ False

☒ Check

## Evaluation (2/2)

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Drag the words into the correct boxes!

The black test tube filled with water  the incident light so that the water is heated. Through the mirror, which  additional light onto the glass, a much greater heating can be achieved. The test tube is directly in the  of the parabolic trough when it is clamped to the glass. In the , light is then reflected from every point of the mirror onto the glass and absorbed there. The condensation that becomes visible after a few minutes illustrates the high temperature inside the tube. The water that evaporates in the middle  again on the cold outer edge.

absorbs

condenses

ideal case

focal line


reflects

☒ Check



Slide	Score / Total
Slide 11: Temperature rise	0/1
Slide 12: Absorption and reflection	0/5

Total score  0/6

 Show solutions

 Repeat

 Export text