

stirling engine

car and experiment kit



SCIENCE EDUCATION SET

WARNING — This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

Experiment Manual

 Thames & Kosmos

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Overview of the experiment kit components



We reserve the right to make technical changes and changes in content.

Mounting the Parabolic Mirror and the Stirling Module

The Parabolic Mirror

For the most part, the experiment kit contains pre-assembled components. But you still have to attach a mounting piece to the back of the parabolic mirror. Secure the mount to the mirror with four screws and four nuts (see Figure 1). The nuts are seated on the inside of the parabolic mirror.

Avoid touching the inside of the parabolic mirror, since it is sensitive to physical impact and fingerprints.

The Stirling Module

The Stirling module is pre-assembled at the factory due to its mechanical complexity. The housing can be opened as needed. The glass cylinder can also be removed by unscrewing the threaded ring. In preparation for operating the Stirling engine, check the movement of the movable elements by turning the hand crank mounted on the generator shaft (see Figure 2).

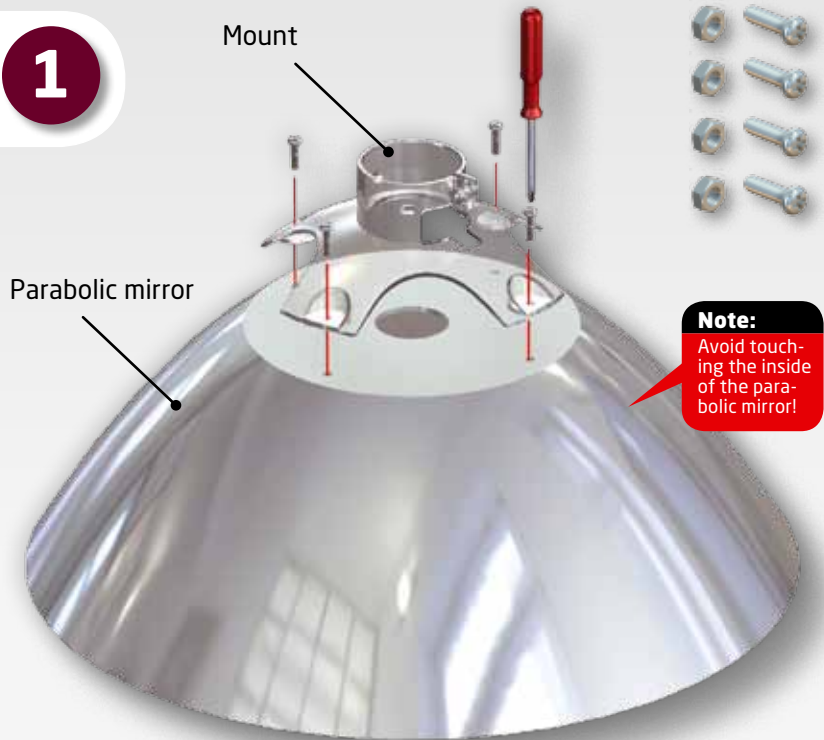
Also check to make sure that the glass cylinder is screwed on tightly with the threaded ring, but do not tighten it with much force! If you tighten it too much, the glass will crack.

The First Assembly

Getting started is easy. We just need the base station, equipped with its built-in voltmeter.

How to: Mount the parabolic mirror

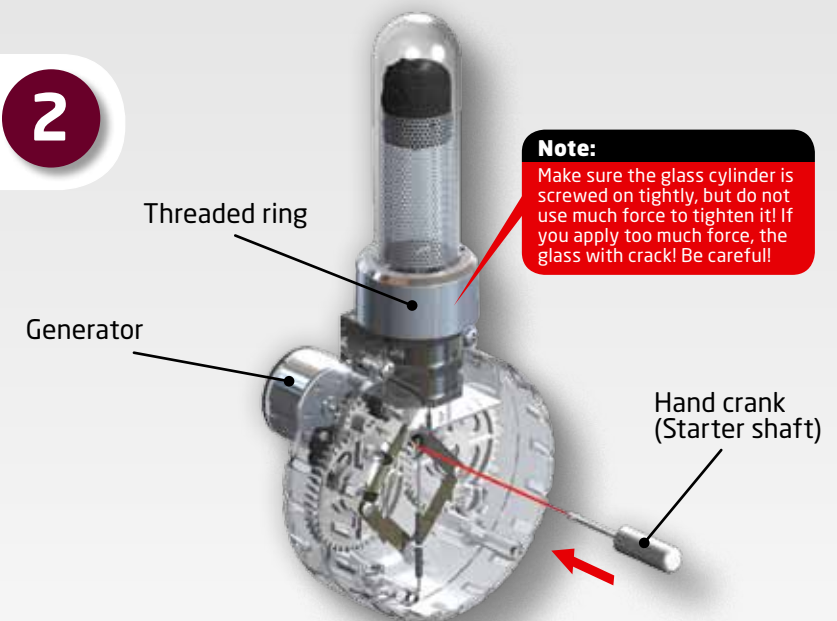
1



Note:
Avoid touching the inside of the parabolic mirror!

How to: Prepare the Stirling module

2



Note:
Make sure the glass cylinder is screwed on tightly, but do not use much force to tighten it! If you apply too much force, the glass will crack! Be careful!

Note: The Stirling engine is now ready for operation.

Assembling a Dish Generator

Insert the Stirling module into the recess and into the two brackets of the base from above (see Figure 3).

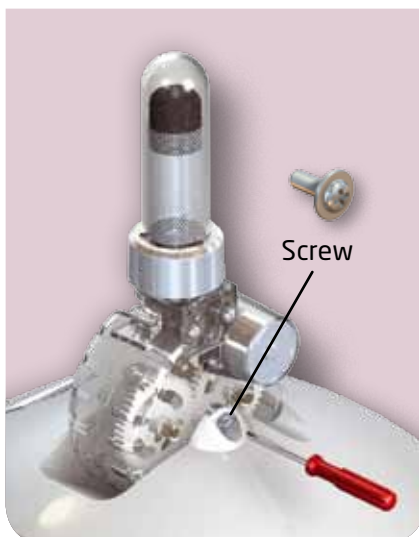
Use the retaining screw included with the experiment kit to secure the Stirling module housing to the base from the rear. The primary function of the screw is to secure the Stirling module in its desired position.

Mounting the Mirror

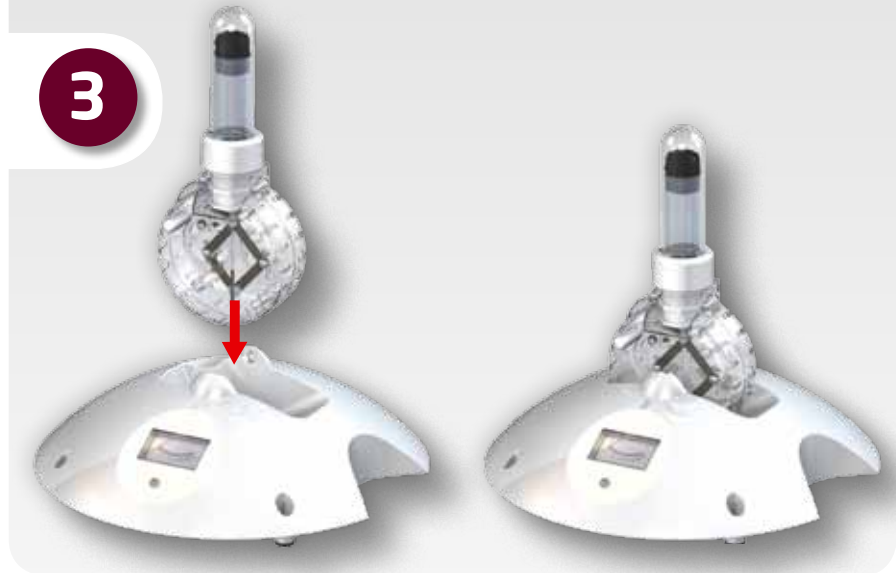
Ideally, you should mount the parabolic mirror in the position shown here. To do this, place the dish's clamp over the glass cylinder. Secure the parabolic mirror assembly unit to the threaded ring of the Stirling module by screwing the clamp on tightly (Figure 4).

Important:

The Stirling module is attached to the base station from behind with the retaining screw. If the screw is loosened, the module can be pivoted.



How to: Mount the Stirling module



How to: Test-mount the parabolic mirror



Note: First fasten the Stirling module with the screw!

Capturing Radiation

Refraction of Light Rays in the Parabolic Mirror

Illustration 1 shows a cross-section of our parabolic mirror.

With its opening of around 4 square decimeters, or 0.04 m² (the flattened bottom doesn't count), the parabolic mirror (or parabolic reflector) captures just under 40 watts of power on a sunny day.

How Does the Mirror Do It?

It is curved in such a way that the parallel sun's rays falling upon it are all concentrated onto a focal point. Here, temperatures can reach up to 250 °C (482 °F).

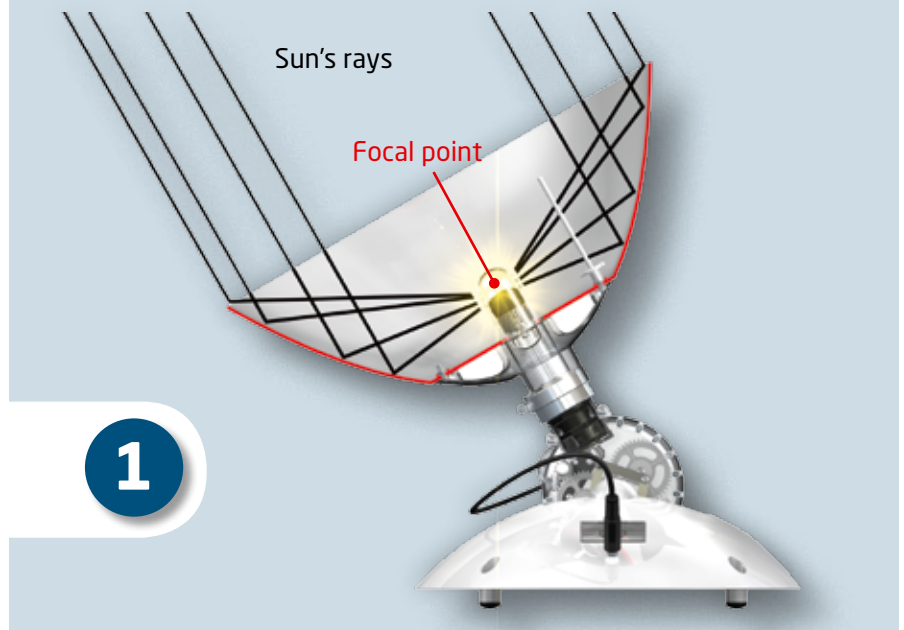
It Needs Direct Sunlight

A parabolic mirror needs direct sunlight. While it can collect scattered radiation, it won't project that radiation onto the focal point.

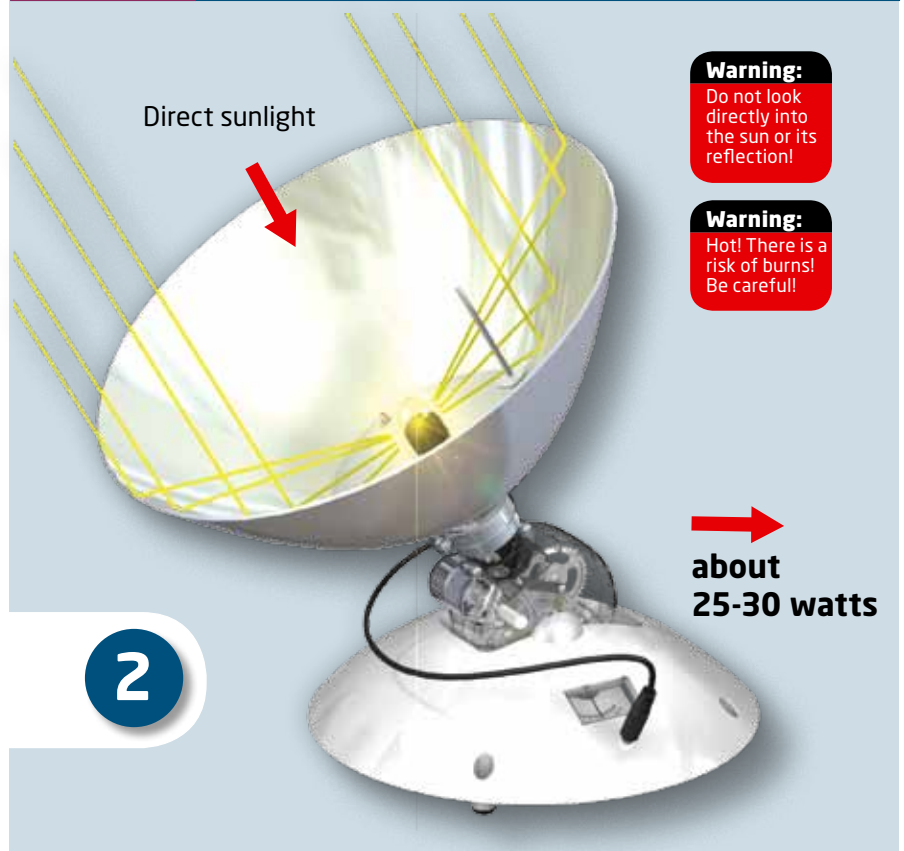
Unfortunately, not all the captured solar energy lands in the space of the compression cylinder. A portion of it (about a tenth) is absorbed by the mirror itself, while another tenth is wasted due to heat loss from the cylinder. If the end of the glass cylinder isn't blackened with candle soot, another 10-20 percent of the power arriving there will "disappear" due to reflection off the shiny glass surface.

Ultimately, we can estimate that about 25-30 watts are still available.

Principle: Refraction in the Parabolic Mirror



Principle: Refraction in the Parabolic Mirror



Note:

A simplified depiction of incoming solar radiation

Filling Up the Car

Test Charge

We will use the experimental setup shown in Figure 3, without the car.

Start the Stirling engine with the alcohol burner flame set at high. Use the small hand crank to start up the Stirling engine and wait for it to warm up. You'll know that it has reached this state when its RPMs – according to the voltmeter – are no longer rising and the engine runs evenly. The charge can be monitored with the voltmeter.

Charging with Solar Energy

We will use the experimental setup shown in Figure 4.

The car's drive switch is set to Off. Insert one of the charging cable's plugs into the socket on the rear side of the Stirling module. Insert the other plug into the car's charging socket. Assuming there is sufficient solar radiation, the battery will start to charge.

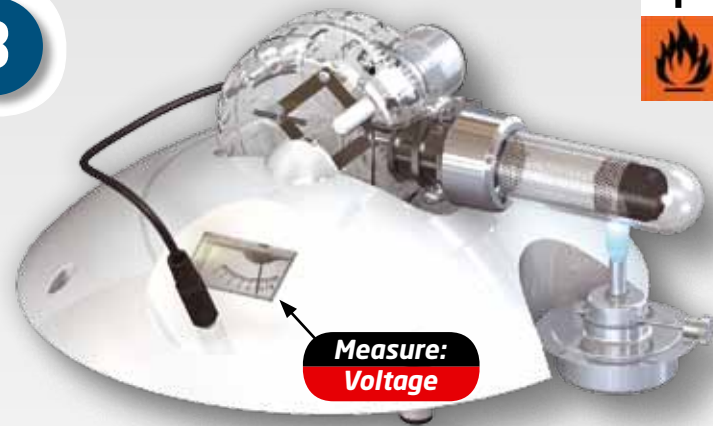
The parabolic mirror will have to be adjusted to the sun's position from time to time. After 2-3 hours of charging time, the battery will have gotten enough energy to power the car for about 5 minutes.

To check the charge level of the battery, just connect the electric car to the base station and read the value on the voltmeter.

How to: Fill up with electricity

3

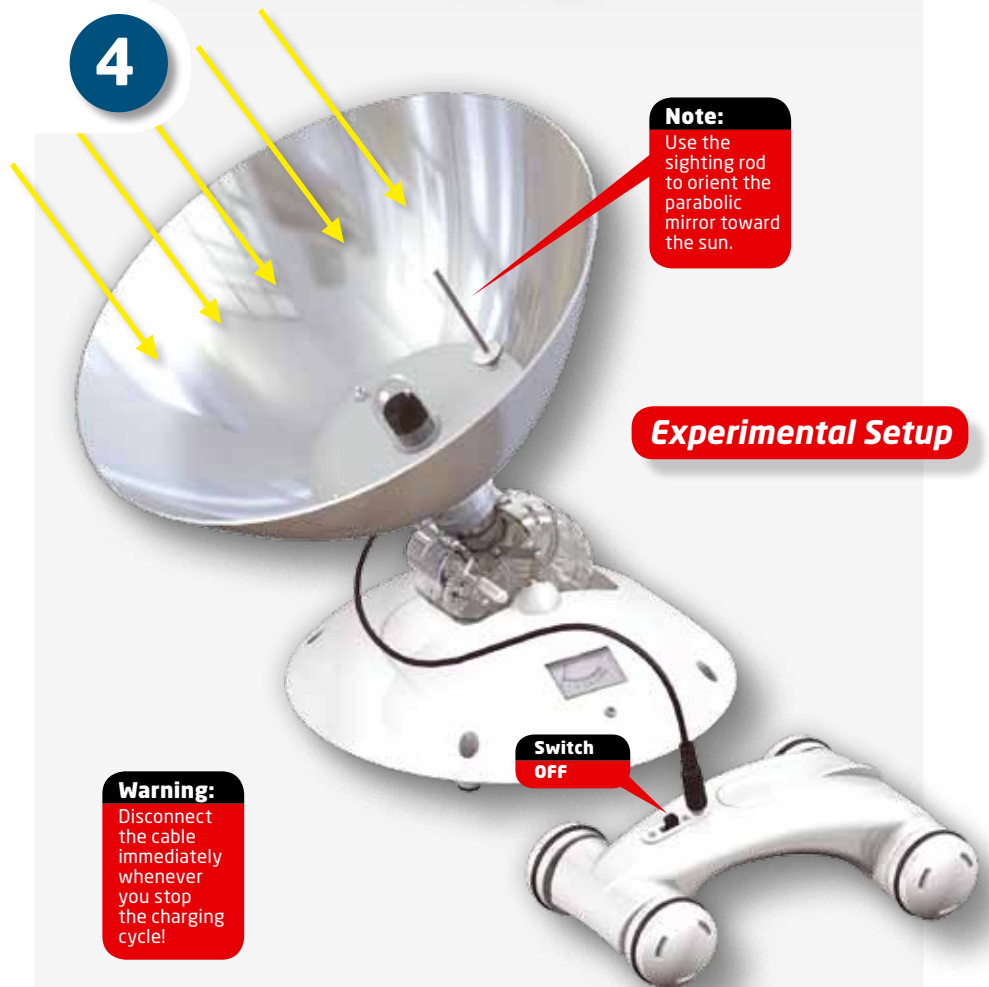
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4

Note:

Use the sighting rod to orient the parabolic mirror toward the sun.



Experimental Setup

Note:

Secure the mirror in place after adjusting it.