

# Dr FuelCell® Model Car

Model Car with Reversible Fuel Cell

The Dr FuelCell® Model Car integrates the subject of renewable energies in the instruction for the lower secondary level in an uncomplicated manner. Its pre-configured experiments make learning science curricula fun.



## Hands-on Teaching of Renewable Energies

The Dr FuelCell® Model Car can be operated with energy from a fuel cell or a solar panel. A reversible fuel cell makes it possible to generate and store hydrogen wherever it is needed. Practical experiments help students easily understand the relationships between energy conversion, storage and consumption.

## Time-tested Quality

Developed for daily use in the classroom, the model car is user-friendly and features a flexible and robust design, making it suitable both for group and individual instruction.

## Extensive Features

The package includes a reversible fuel cell, which functions both as a hydrogen generator and fuel cell. The fuel cell uses the energy supplied by the solar panel or the hand generator to separate water into oxygen and hydrogen. In fuel cell mode, the stored hydrogen is converted into electric power to operate the car. The load measurement box makes it possible to measure the current and voltage.

## Flexible Applications

Instructors can use the Dr FuelCell® Model Car to teach content from the curricula of physics and chemistry for the lower secondary level:

- » Water: element or compound
- » Chemical reactions
- » Energy conversion
- » Paths of electricity – circuit systems
- » Experimenting, logging and analyzing
- » Planning and implementation of project-related tasks

- » Immediately ready to use; no further materials are needed
- » Curriculum oriented instruction manual (Grades 5 – 10)
- » Instruction manual and teacher's guide for experiments
- » Fast and easy preparation for class with experiment materials that can be copied and printed
- » Robust design and exceptional quality
- » Variable setup – fuel cell, solar operation and hybrid
- » Hand generator allows operation anywhere

# Components

Dr FuelCell® Model Car

The single components of the Dr FuelCell® Model Car can be used in various ways for instruction. Discover the features.



Storage Box

## Reversible Fuel Cell with integrated Gas Storage Cylinders



This component is a fuel cell and hydrogen generator in one. It is operated with distilled water and requires no caustic solutions or acids. The generated hydrogen is stored in integrated gas storage cylinders, safely and directly.

## Solar Panel



The 5-cell photovoltaic module is used for experiments in solar energy and for generating electric energy for hydrogen production. The practical base facilitates alignment to the light source. The module can easily be mounted on the car chassis to make a solar vehicle.

## Load Measurement Box



The load measurement box for recording data is used for advanced experiments. Integrated consumers, such as a motor, a lamp and 7 selectable resistors, enable numerous experiments, e.g. recording characteristic curves, or current and voltage.

## Hand Generator



The high-quality hand generator, which simulates wind power, is an alternative to the solar panel. Muscle power is used to generate electrical energy for the separation of water in the reversible fuel cell.

## Car Chassis



The car chassis is designed both for fuel cell operation and solar operation. A single click and two cable connectors are all you need to make the switch. The front axis is steerable and lockable, so the car chassis can also be used where space is limited.

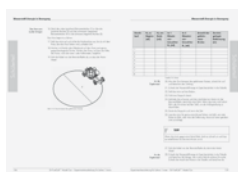
# Supplementary Material



Ring Binder



CD-ROM



Teacher's Guide

The three-section ring binder included with the system contains all materials as masters for copying:

- » Quick guide for a fast introduction to the experiment setups and functions
- » Detailed instruction manual for understanding of details and preparation of additional individual experiments
- » Teacher's guide with a large selection of experiments for grades 5 – 10, subdivided according to age and level of difficulty

All documents are also provided on CD-ROM in PDF format for further use. Every experiment description includes a section with background information on the subjects treated, in addition to a teacher's section and a student's section.

The teacher's section includes all information about the experiment, all assignments and solutions, as well as complete results of the experiment. The student's section includes not only the experiment description, but also forms for recording measured data and assignments for the different age groups.

### Examples of experiments:

- » Proper alignment of solar panels
- » Understanding electrolysis
- » Hydrogen energy in motion: work, output, friction
- » Efficiency
- » What is a hybrid?

# Product Options

Dr FuelCell® Model Car		
<b>Demo</b>		<b>Complete</b>
Features numerous basic demonstration experiments for classes in physics, chemistry and technology		Load Measurement Box allows for quantitative analyses, the Hand Generator offers an alternative to power generation with the Solar Panel
<ul style="list-style-type: none"> <li>» Reversible Fuel Cell</li> <li>» Solar Panel</li> <li>» Chassis</li> <li>» Instruction Material with Teacher's Guide</li> <li>» Distilled water</li> <li>» Cable Set</li> </ul>		<ul style="list-style-type: none"> <li>» Reversible Fuel Cell</li> <li>» Solar Panel</li> <li>» Chassis</li> <li>» Load Measurement Box</li> <li>» Hand Generator</li> <li>» Instruction Material with Teacher's Guide</li> <li>» Distilled water</li> <li>» Cable Set</li> </ul>
	Item No. 352	Item No. 354
Accessories		
Lamp	Lighting fixture & special bulb for simulating sunlight, not available for 110 volts	Item No. 314



### Dr FuelCell® Classroom Bundle III

#### Included

- 6 x Dr FuelCell® Model Car Complete\*
- 1 x Dr FuelCell® Model Car Instruction Material
- 1 x CD-ROM

Item No. 926

\*without Instruction Material

# Technical Data

## Dr FuelCell® Model Car Complete

All Dr FuelCell® Model Car packages include the main components and the necessary cables for the experiments, in addition to a stop watch.

Dimensions (W x H x D)	345 mm x 160 mm x 280 mm
Weight	ca. 2.9 kg
Permissible ambient temperature during operation	+10 ... +35 °C
Language versions	German, English, French, Spanish, Italian, Turkish, Japanese, Korean and Arabic

## Reversible Fuel Cell

Dimensions (W x H x D)	80 mm x 80 mm x 70 mm
Storage volume for hydrogen and oxygen	15 ml each

## Electrolysis Mode

Operating voltage	1.4 ... 1.8 V
Operating current	0 ... 500 mA
Hydrogen production	max. 3.5 ml / min

## Fuel Cell Mode

Operating voltage	0.5 ... 0.9 V
Operating current	0 ... 500 mA
Rated output	250 mW

## Solar Panel

Dimensions (W x H x D)	80 mm x 130 mm x 52 mm
Terminal voltage	2.5 V (*)
Short circuit current	200 mA (*)
Current	180 mA (*)
Voltage	2 V (*)
Output	0.36 W (*)

(\*) Typical measured values with a 120 watt PAR lamp from Heliocentris, at a distance of 20 cm.

## Load Measurement Box

Dimensions (W x H x D)	190 mm x 110 mm x 60 mm
Operating voltage of motor	0.2 ... 3 V
Current consumption of motor	10 ... 15 mA
Operating voltage of lamp	0.6 ... 1.5 V
Current consumption of lamp	80 mA
Measured resistance (in Ω)	1, 3, 5, 10, 50, 100, 200 Ω, open and short circuit
Ammeter	0 ... 2 A
Voltmeter	0 ... 20 V DC

## Hand Generator

Dimensions (W x H x D)	55 mm x 137 mm x 55 mm
No-load voltage	2.1 V
Typical operating voltage with electrolyzer	ca. 1.7 V

## Car Chassis

Dimensions (L x W x H)	195 mm x 110 mm x 50 mm
Operating voltage of motor	0.5 ... 3 V
<b>With Reversible Fuel Cell</b>	
Hydrogen consumption	3 ... 5 ml/min
Running time with full gas storage cylinders	3 ... 5 min

The output of the fuel cell depends on various influencing factors and decreases over the life of the product. All information on the output applies at the time of delivery.

The systems use hydrogen, a highly flammable gas. This requires compliance with local laws and safety regulations for transport, storage and operation. Read the operating manual carefully before setting up and operating the system.

We reserve the right to make changes without prior notice.

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