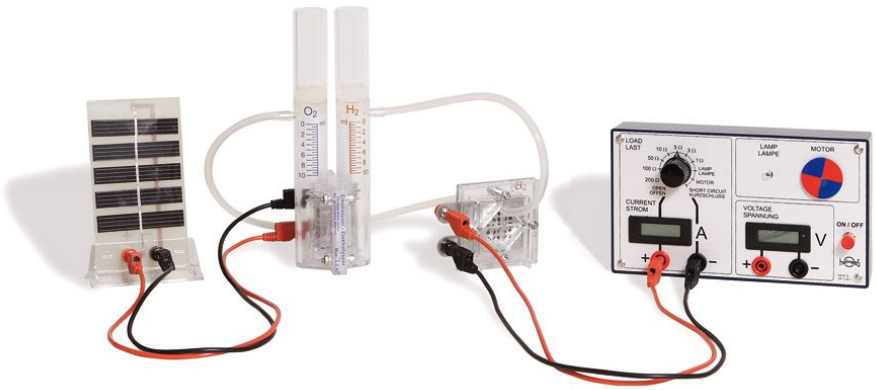
Heliocentris

Dr FuelCell® Science Kit

Student Science Kit for Solar Hydrogen Technology

The Dr FuelCell® Science Kit is an extensive experiment set for the subject of renewable energies. Flexible components, 20 pre-configured experiments and detailed supplementary material make it a complete solution for teaching physics and chemistry in grades 9–12.



A Complete Energy Cycle

The Dr FuelCell® Science Kit reproduces a complete solar hydrogen energy cycle. It makes it possible to approach the subject of renewable energies both as a complete cycle and at the level of the single technologies of photovoltaics and the fuel cell.

Extensive Features

The package includes a solar panel, an electrolyzer with two graduated storage cylinders, a fuel cell and a load measurement box. A methanol fuel cell and a take-apart fuel cell are optional.

The solar panel produces energy for the electrolyzer. The generated hydrogen is stored intermediately in graduated storage cylinders and converted to electric power by the fuel cell. The load measurement box is used to simulate consumers and to measure electric current and voltage. All technical components can also be used and examined separately.

The optional fuel cell types offer the possibility to gain in-depth knowledge of the specific functions and components of fuel cells, for example as a unit of instruction for the upper secondary level.

Interdisciplinary Applications

The curriculum oriented documentation of the Dr FuelCell® Science Kit contains more than 20 pre-configured experiments with technical background information as an ideal preparation aid for instruction.

The system is suitable for content from the curricula of physics and chemistry for the lower and upper secondary level:

» Molecules and chemical reactions
» Reaction speeds
» Thermodynamics
» Electrochemistry
» Energy conversion and efficiency
» Measuring and interpreting characteristic curves
» Planning and implementation of scientific experiments

» Curriculum oriented instruction material (Grades 9 –12)
» 20 pre-configured experiments for individual or group work
» Immediately ready to use; no additional materials are needed[1]
» Robust and user-friendly components
» Practical and easy-to-operate load measurement box for measuring current and voltage
» Expandable, to gain expert knowledge of fuel cells

[1] Not included: distilled water

Components

Dr FuelCell® Science Kit

The components of the Dr FuelCell® Science Kit can be used in various ways for instruction. Discover the features.

Storage Box

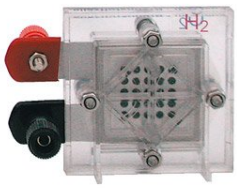
Solar Panel

The 5-cell photovoltaic module is used for experiments in solar energy and for generating electric energy for the hydrogen generator. The practical base facilitates alignment to the light source.

Electrolyzer

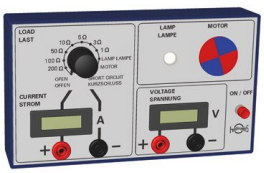
The electrolyzer separates water into hydrogen and oxygen. It is operated with distilled water and requires no caustic solutions or acids. The integrated graduated hydrogen storage cylinders visualize the classic hydrogen separation experiment, as in the Hoffmann apparatus.

Fuel Cell



The fuel cell generates electrical energy from hydrogen and oxygen. It is based on PEM technology, which is the most widespread technology used in the development of fuel cell applications, e.g. for motor vehicles or stationary power supply systems.

Load Measurement Box



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

Take-apart Fuel Cell

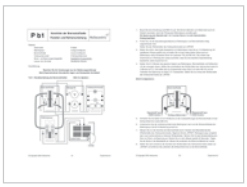
The take-apart fuel cell makes it possible to examine the functions and the design of a fuel cell in detail. A plug-in resistor, an electrode with reduced catalyst quantity and an air panel for air instead of oxygen operation enable in-depth experiments.

Methanol Fuel Cell

The methanol fuel cell uses methanol instead of hydrogen to generate electrical energy. This makes it possible to conduct more extensive experiments. The package includes storage cylinders for storage of the methanol solutions.

Supplementary Material

Instruction Material



Teacher's Guide

The 4-volume instruction material of the Dr FuelCell® Science Kit is designed for the lower and upper secondary level and consists of three experiment volumes and one volume with background information.

The experiment volumes cover a broad spectrum of subjects from the physics and chemistry curricula:

» Student assignments for independently conducting experiments both individually and in groups

» Detailed teacher's guides with instructions for experiments, sample results and interpretations

» Worksheets with short articles and written assignments for independent use in class or at home

The fourth book, "Principles and Applications", includes articles with background information that can be used independently in classes.

The accompanying USB flash drive includes two videos and two PowerPoint presentations on the principles and applications of fuel cell technology and two experiments with the Dr FuelCell® Science Kit.

USB flash drive

Examples of experiments:

» Current/voltage characteristic curves of solar panel and fuel cell
» Faraday's first law
» Electrolysis
» Dependence of solar current on the distance and incident angle of the light source
» Series and parallel connection of solar and fuel cells
» Water = 2 parts hydrogen + 1 part oxygen

Product Options

Dr FuelCell® Science Kit	
Basic	**Complete**
Features numerous preconfigured basic experiments for classes in physics, chemistry and technology	Basic experiments and in-depth experiments with different fuel cell types
» Solar Panel » Electrolyzer » Fuel Cell » Load Measurement Box » USB - Instruction Material with Teacher's Guide	» Solar Panel » Electrolyzer » Fuel Cell » Load Measurement Box » Take-apart Fuel Cell » Methanol Fuel Cell » USB - Instruction Material with Teacher's Guide
Item No. 350	Item No. 355

Accessories		
Lamp	Lighting fixture & special bulb for simulating sunlight, not available for 110 volts	Item No. 314
Hand Generator	For simulating wind energy	Item No. 345

+

Dr FuelCell® Classroom Bundle II

Included
6 x Dr FuelCell® Science Kit Basic*
1 x Dr FuelCell® Science Kit Instruction Material
1 x USB flash drive

Item No. 916

*without Instruction Material

Technical Data

Dr FuelCell® Science Kit Complete	
All Dr FuelCell® Science Kit packages include the main components and all necessary accessories for the experiments, such as tubes, plugs, cables and a stop watch.	
Dimensions (W x H x D)	430 mm x 150 mm x 310 mm
Weight	ca. 5.6 kg
Permissible ambient temperature during operation	+10 … +35 °C
Language versions	The instruction material and the USB flash drive are available in German and English.

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 (*)
In the operating point with a load resistance of 10 Ω	
Current	180 mA (*)
Voltage	2.0 V (*)
Output	0.36 W (*)

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

Electrolyzer	
Dimensions (W x H x D)	80 mm x 195 mm x 85 mm
Storage volume for hydrogen and oxygen	10 ml each
Operating voltage	1.4 ... 1.8 V
Electric current	max. 500 mA
Hydrogen production	max. 3.5 ml / min (at 500 mA)

Fuel Cell	
Dimensions (W x H x D)	65 mm x 85 mm x 38 mm
Voltage	0.4 ... 0.9 V
Current	max. 1,000 mA
Rated output	0.25 W

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, open and short circuit
Ammeter	0 ... 2 A
Voltmeter	0 ... 20 V DC

Take-apart Fuel Cell	
Dimensions (W x H x D)	85 mm x 65 mm x 65 mm
Voltage	0.4 ... 0.9 V
Current in oxygen mode	max. 1,500 mA
Current in air mode	max. 800 mA
Rated output for oxygen mode	0.3 W

Methanol Fuel Cell*	
Dimensions (W x H x D)	65 mm x 85 mm x 34 mm
Voltage	0.1 ... 0.5 V
Current	max. 65 mA (typ.)
Rated output	5 mW typ. (with 1 M methanol solution)

*Individual cell performance may vary due to manufacturing tolerances.

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.

Science Kit_Brochure_EN_2604

Heliocentris

Heliocentris Academia International GmbH
Rudower Chaussee 30
12489 Berlin, Germany

Tel. + 49 (0) 30 340 601 600
sales@heliocentrisacademia.com
www.heliocentrisacademia.com

Available from: