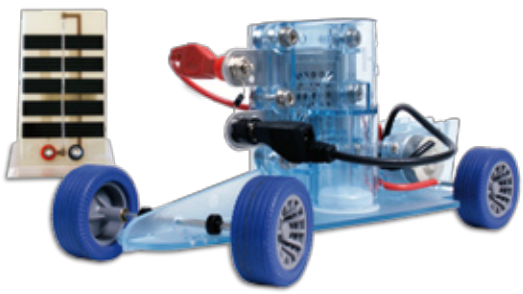
Heliocentris

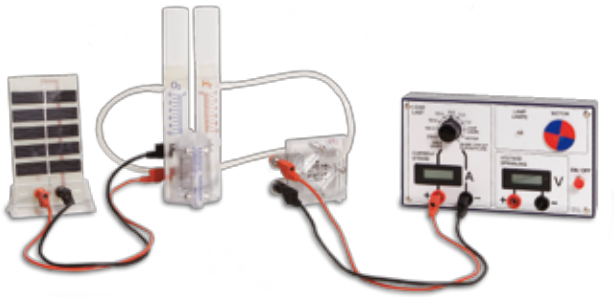
Solar Hydrogen and Fuel Cell Technology

Products for Science Education



Inspire Your Students

Renewable Energies in Science Education



The Dr FuelCell® Range

For science education Heliocentris offers teaching products with comprehensive instruction material. Solar and hydrogen technology can easily be integrated into school classes or introductory courses in higher education.

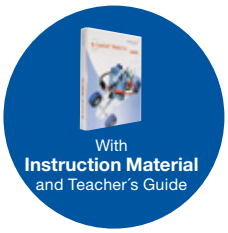
Content

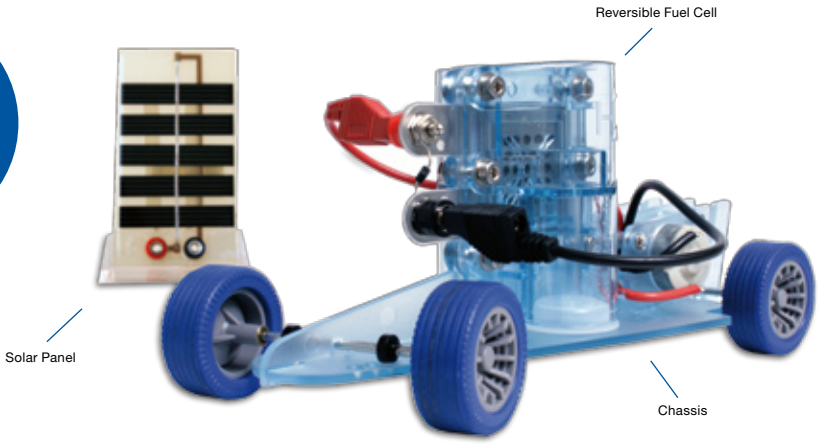
Quality from Heliocentris

» More than 10 years of experience in fuel cell technology
» More than 10,000 systems sold worldwide
» Superior product quality
» German engineering

Dr FuelCell® Model Car

Solar & Hydrogen Model Car for Science Lessons






Load Measurement Box


Hand Generator


Storage Box

The Dr FuelCell® Model Car integrates the subject of renewable energies into the classroom in an uncomplicated manner. Preconfigured experiments make learning science curricula fun.

The Model Car can be operated with energy from the reversible fuel cell or the solar panel. The fuel cell allows to generate and store hydrogen more easier than using the Hofmann apparatus. All components can be flexibly combined with each other. The robust model car is suitable for group and individual instruction. A curriculum-oriented instruction manual as well as a teacher's guide with experiment materials that can be copied and printed allow for a fast and easy preparation for class.

Areas of Application

Suitable for teaching content from the curricula of physics and chemistry for the lower secondary level:

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

Sample Experiments

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

Product Options

Demo	Complete
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
» Reversible Fuel Cell » Solar Panel » Chassis » Instruction Material with Teacher´s Guide » Distilled water » Cable set	» Reversible Fuel Cell » Solar Panel » Chassis » Load Measurement Box » Hand Generator » Instruction Material with Teacher´s Guide » Distilled water » Cable set
Item no. 352	Item no. 354

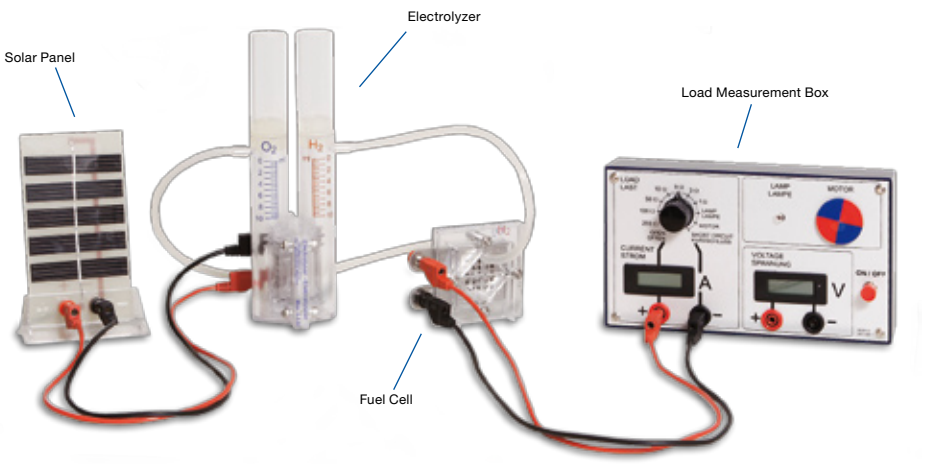
Accessories

Lamp	Lighting fixture & special bulb for simulating sunlight, not available for 110 volts	Item no. 314

Dimensions (W x H x D): 345 x 160 x 280 mm, Weight: ca. 2.9 kg

Dr FuelCell® Science Kit

Student Science Kit for Solar & Hydrogen Technology



Methanol Fuel Cell

Take-apart Fuel Cell

Storage Box

The Dr FuelCell® Science Kit is an extensive experiment set for the subject of renewable energies. 20 preconfigured experiments and detailed supplementary material make it a complete solution for teaching physics and chemistry.

The components reproduce a complete solar hydrogen energy cycle and can be flexibly combined with each other. The subject of renewable energies can be approached as a complete cycle and at the level of the single technologies of photovoltaics and the fuel cell. All components can be used and examined separately.

The curriculum-oriented instruction material supports with more than 20 preconfigured experiments and technical background information the preparation for class.

Areas of Application

Suitable for teaching content from the curricula of physics and chemistry:

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

Sample Experiments

» 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

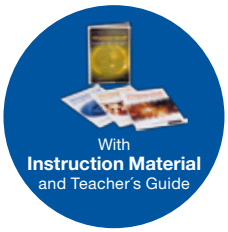
Basic	Complete
Features numerous preconfigured basic experiments for classes in physics, chemistry and technology	Basic experiments and in-depth experiments with different fuel cell types
» Solar Panel » Electrolyzer » Fuel Cell » Load Measurement Box » Instruction Material with Teacher's Guide	» Solar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

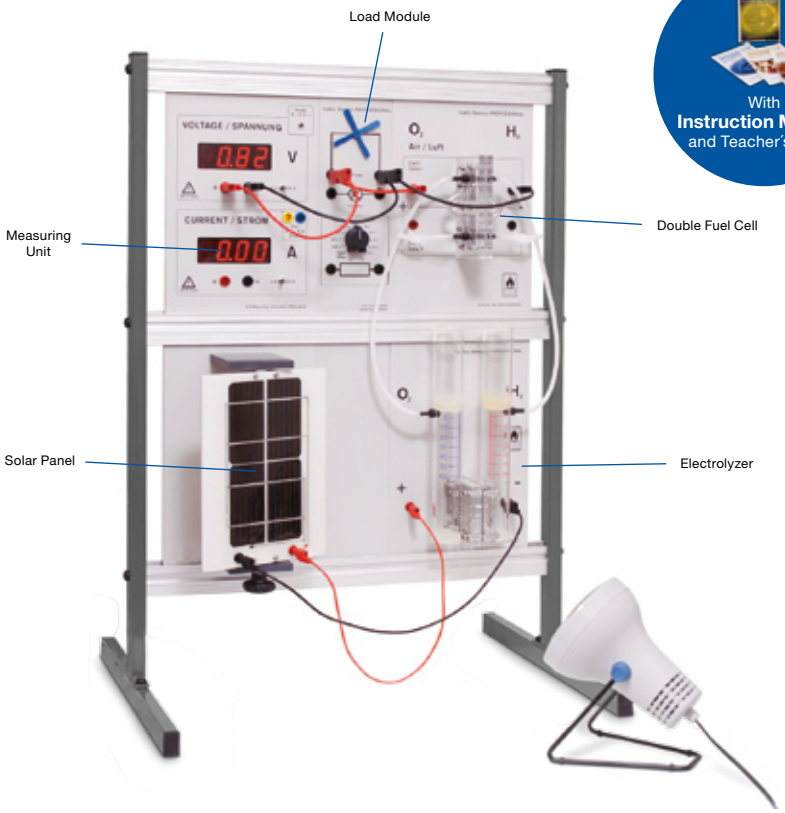
Accessories		
Lamp	Lighting fixture & special bulb for simulating sunlight, not available for 110 volts	Item no. 314
Hand Generator	For simulating wind energy	Item no. 345

Dimensions (W x H x D): 430 x 150 x 310 mm, Weight: ca. 5.6 kg

Dr FuelCell® Professional

Training and Demonstration Unit for Solar & Hydrogen Technology





The Dr FuelCell® Professional is designed for class demonstrations of experiments and hands-on use by students. The system represents a complete energy cycle based on solar-hydrogen fuel cell technology.

Solar and fuel cell technology can be examined in detail and portrayed within the context of the overall concept. Large components and easy-to-read displays are ideal for group presentations and demonstrations. Preconfigured experiments and the curriculum-oriented documentation facilitate class preparation. The system can also be operated by students.

Areas of Application

Suitable for teaching numerous subjects of physics, chemistry and technology:

» Molecules and chemical reactions
» Reaction speeds
» Thermodynamics
» Electrochemistry
» Energy conversion and efficiency
» Measuring and interpreting characteristic curves

The system is also suitable for basic practical experiments in the natural sciences and technological subjects.

Sample Experiments

» Current and voltage characteristic curves of solar panel and fuel cell
» Faraday‘s first law
» Electrolysis
» Faraday and energy efficiency of an electrolyzer and of a fuel cell
» Thermodynamics: electrochemical processes
» Series and parallel connection of fuel cells
» Water = 2 parts hydrogen + 1 part oxygen

Product Options

Demo	Complete
Features numerous hands-on experiments for classes in physics, chemistry and technology	Features full range of experiments and visualization of measured data through an additional measuring unit
» Solar Panel » Electrolyzer » Double Fuel Cell » Load Module » Instruction Material with Teacher´s Guide	» Solar Panel » Electrolyzer » Double Fuel Cell » Load Module » Measuring Unit » Instruction Material with Teacher´s Guide
Item no. 391	Item no. 392

Accessories

Lamp	Lighting fixture & special bulb for simulating sunlight, not available for 110 volts	Item no. 314

Dimensions (W x H x D): 600 x 840 x 460 mm, Weight: ca. 10.1 kg

Dr FuelCell® Classroom Bundles

The Economic Solution for the Entire Class

Dr FuelCell® Classroom Bundles are designed for hands-on learning in small groups of three to four students. Instruction material is only included once to reduce costs and avoid redundancy.

Dr FuelCell® Classroom Bundle I

The Classroom Bundle I includes the product Dr FuelCell® Professional to facilitate experiments in front of the class. It is based on the same didactic concept as the included Science Kits.

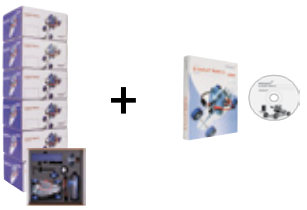
Included
1 x Dr FuelCell® Professional Demo
6 x Dr FuelCell® Science Kit Basic*
1 x Dr FuelCell® Science Kit Instruction Material
1 x CD-ROM

Item no. 915

Dr FuelCell® Classroom Bundle II

Included
6 x Dr FuelCell® Science Kit Basic*
1 x Dr FuelCell® Science Kit Instruction Material
1 x CD-ROM

Item no. 916



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

Accessories		
Lamp Set	Set of 6 lamps for simulation of sunlight. Suitable for all Classroom Bundles	Item No. 917
Measuring Unit	Upgrade of Classroom Bundle I, measuring unit for current and voltage	Item No. 379

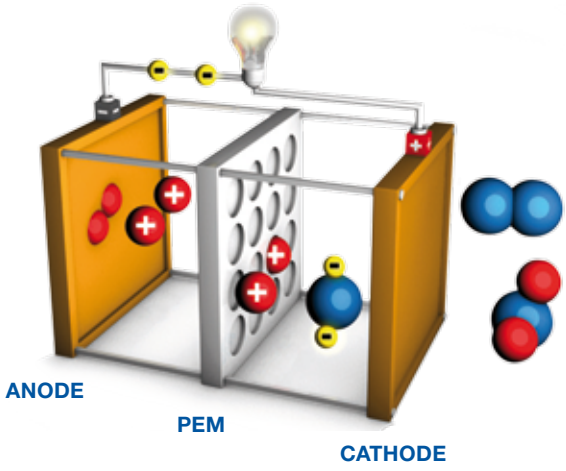
* without Instruction Material

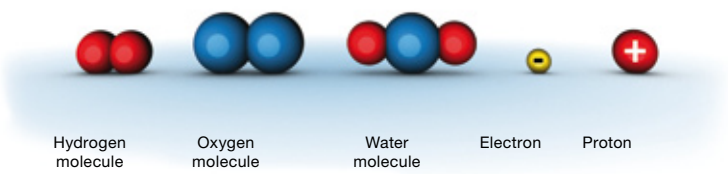
How a Fuel Cell Works

A fuel cell converts the chemical energy arising from the reaction between hydrogen (H_2) and oxygen (O_2) directly into electrical energy, water and heat.

It consists of an anode and a cathode which are separated by an electrolyte. In PEM fuel cells a proton exchange membrane is used as electrolyte. The anode is supplied with hydrogen and the cathode is supplied with oxygen. At the anode the hydrogen molecules are split in electrons and protons.

If anode and cathode get electrically connected, the protons move through the electrolyte (PEM) to the cathode. The electrons run via an external electrical connection to the cathode while driving an electrical load. At the cathode protons and electrons react to water with the supplied oxygen.





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