



*Material:*

Item Code	Qty.	Description
P2820-3B	1	Fuel cell – unit for electro-car

Additional required:

P3130-3D	1	Low-voltage power supply with digital display
or		
P3118-1B	1	Battery case 3V, with 4-mm plugs

When we supply electrical energy to a fuel cell, we can split water into oxygen and hydrogen. In this case, the fuel cell acts as an 'electrolyser'.

Since we only need hydrogen to power our fuel cell car, we only capture this gas with our fuel cell unit.

Setup:

The fuel cell unit is placed on the table.

Put approximately 2–3 ml of distilled water into the small syringe.

The red cap on the hose on the red 'oxygen' side is removed and the syringe is attached to this hose.

The cell is filled with distilled water until it emerges again at the lower hose connection.

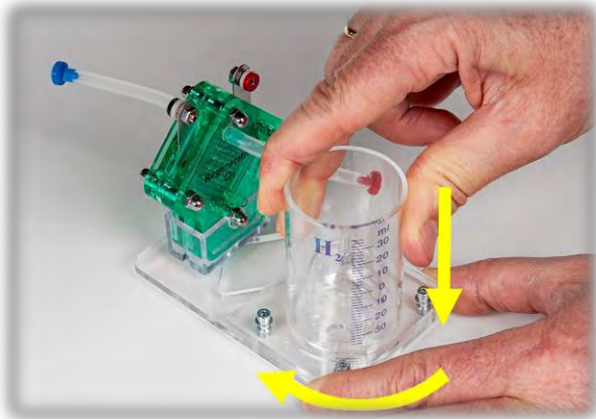
The membrane is now moistened with water. The syringe is removed from the tube again and the end of the tube is closed with the red cap.



The gas bell is pressed onto the base plate of the cylinder so that it is firmly secured there.



The side slits of the gas bell must be within the circular base segments. This is the only way water can enter the bells.



The cylinder is placed on the base plate of the fuel cell unit and locked in place by turning it.

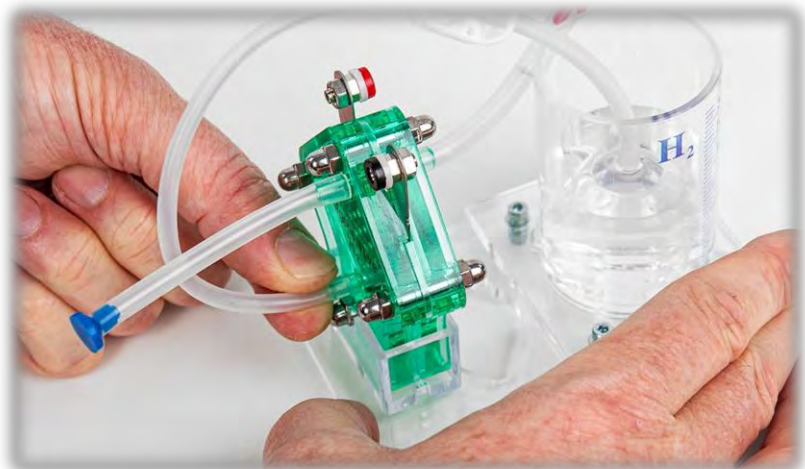
The silicone hose with shut-off valve is attached to the gas bell. This valve must be open.



The cylinder is filled with water up to the '0' mark.

It must be ensured that the gas bell is also completely filled with water.

The free end of the long hose is connected to the lower hose connection (hydrogen side) of the fuel cell.



# GENERATION OF HYDROGEN

AED 7.3

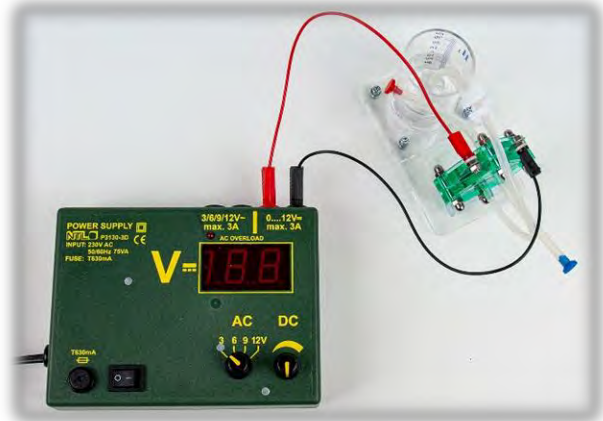
Option A - Gas generation with power supply unit:

Check and ensure that the power supply unit is switched off and the voltage control knob is turned to 'zero'.

If this is the case, the power supply unit is connected to the fuel cell.

**PAY ATTENTION TO POLARITY!**

Incorrect polarity can destroy the cell!

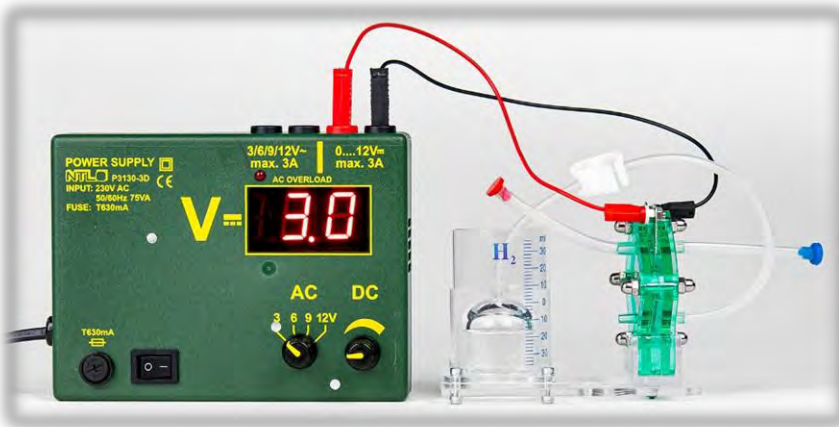


After checking that the cables have been connected with the correct polarity, switch on the power supply unit.

The voltage at the power supply unit is increased to 3.0 volts.

The water level in the bell is monitored.

What happens?



Result:

The fuel cell produces hydrogen, which is collected in the bell jar.

The gas pushes the water out of the bell.



Once approximately 20 ml of hydrogen ( $H_2$ ) has been produced, the power supply is stopped by disconnecting the cables from the power source.

The shut-off valve on the hose is closed by gently squeezing the clamp together.

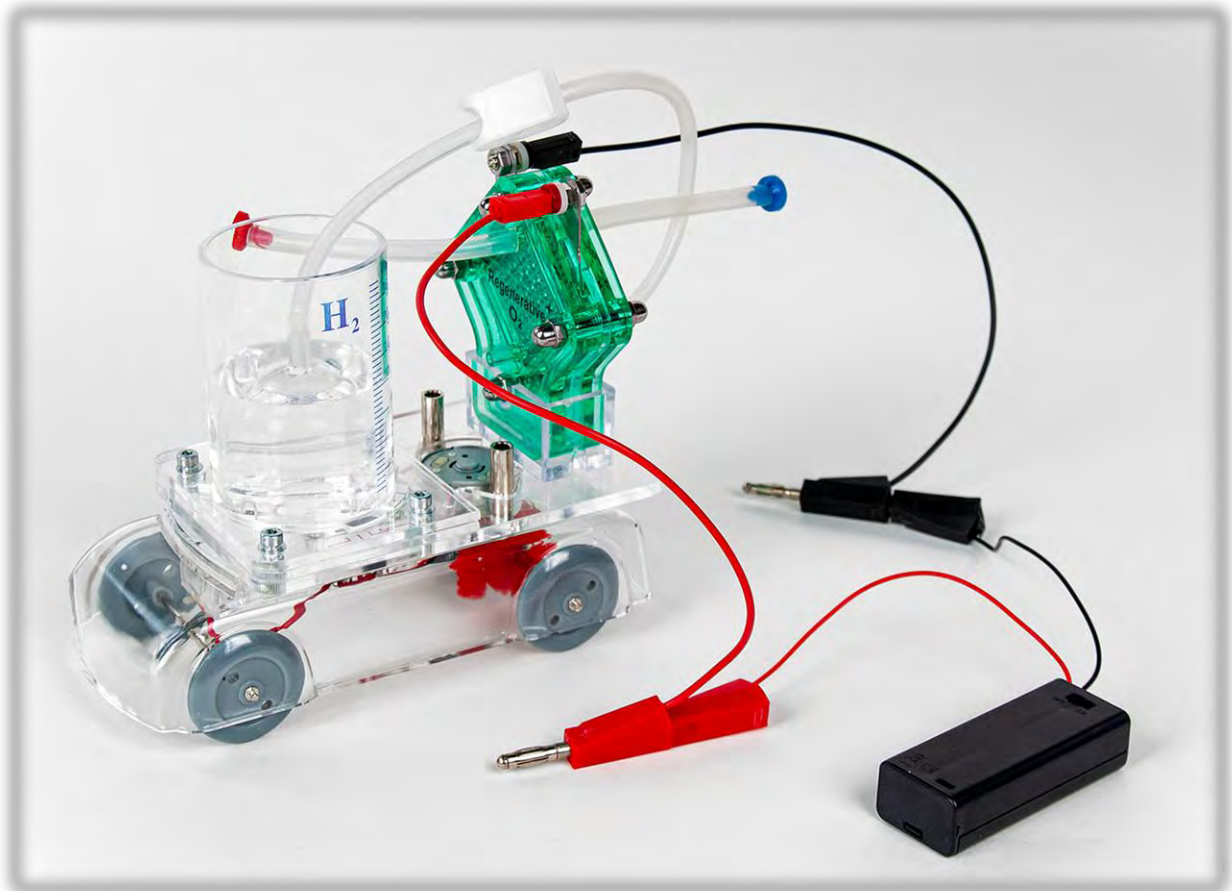
Option B - Gas generation with battery case:

Check that the switch on the battery case is in the 'OFF' position.

If this is the case, the battery box is connected to the fuel cell.

**PAY ATTENTION TO  
POLARITY!**

Incorrect polarity can destroy the cell!



After checking that the cables have been connected with the correct polarity, switch on the switch on the battery case.

The water level in the bell is observed. What happens?

Result:

The fuel cell produces hydrogen, which is collected in the bell jar.  
The gas pushes the water out of the bell jar.

Once approximately 20 ml of hydrogen ( $H_2$ ) has been produced, the power supply is stopped by disconnecting the cables from the battery box.

The shut-off valve on the hose is closed by gently squeezing the clamp.

### **Erkenntnis:**

Elektrische Energie wird durch die Brennstoffzelle (den Elektrolyseur) in elektrochemische Energie umgewandelt. Diese Energie teilt das Wasser in die beiden Gase Wasserstoff und Sauerstoff.

In unserem Versuch haben wir den Wasserstoff in einem Behälter aufgefangen.

### **Hinweise zur Behebung technischer Probleme:**

**Wird trotz der Zuführung von elektrischer Energie kein, oder zu wenig Gas produziert, prüfen Sie bitte folgende Lösungsansätze:**

#### *Lösung 1:*

*Prüfen Sie die Kabelanschlüsse an der Zelle. Die richtige Polarität ist besonders wichtig, da ansonsten die Zelle zerstört werden kann.*

#### *Lösung 2:*

*Prüfen Sie mit einem Messgerät die Spannung am Ausgang der Spannungsversorgung. Die Spannung sollte mehr als 2,5 Volt und weniger als 3,5 Volt betragen. Ist das nicht der Fall, wechseln Sie die Batterien: Bei Verwendung des Netzgerätes bitte die Spannung genau einstellen.*

#### *Lösung 3:*

*Die Schlitze am Rand der Gasglocken müssen mittig in den Bodensegmenten sein, ansonsten kann das Wasser aus der Glocke nicht entweichen. Ist das nicht der Fall, die Glocken entsprechend verdrehen.*

#### *Lösung 4:*

*Die Membran muss wieder benetzt werden. Füllen Sie dazu mit der kleinen Spritze destilliertes Wasser in den Schlauchanschluss der „roten“ Sauerstoff-Seite der Zelle ein. Vor Stromzufuhr bitte 3 Minuten warten damit die Membran richtig benetzt wurde.*

# THE FUEL CELL CAR, THE 'CLEAN' DRIVE SYSTEM

AED 7.4



## Material:

Item Code	Qty.	Description
P1314-1M	1	Electric car, model
P2820-3B	1	Fuel cell – unit for electric-car

# THE FUEL CELL CAR, THE 'CLEAN' DRIVE SYSTEM

AED 7.4

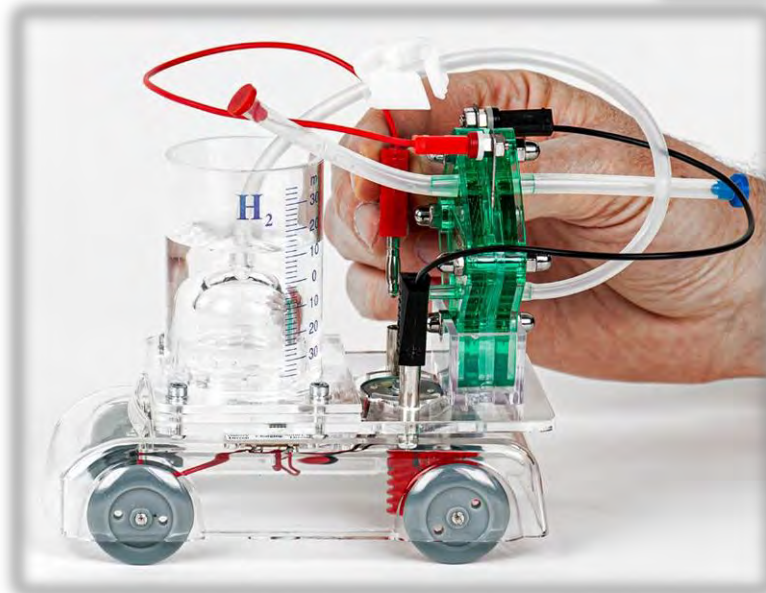
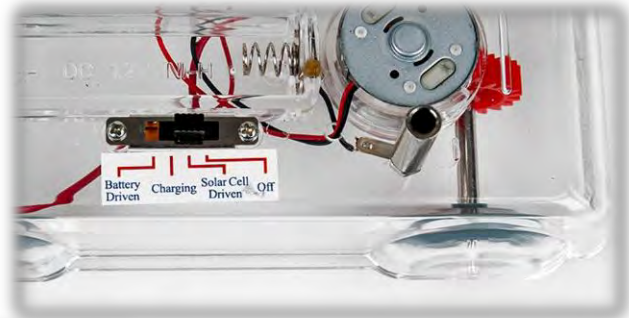
In experiment 7.3, we used the fuel cell (the electrolyser) to generate approximately 20 ml of hydrogen ( $H_2$ ) and collected it in a gas bell.

We can use this gas to 'recover' electrical energy through our reversible fuel cell – and thus power a small electric car.

Experiment:

The position of the switch is checked on the top of the electric car.

It must be in the 'Solar Cell Driven' position (this supplies the motor via the two 4 mm sockets).



The electric car is placed on the table.

The fuel cell unit is mounted on top of the electric car.

The unit must remain in a vertical position so that the water does not spill out of the cylinder.

The fuel cell is now connected to the 4 mm sockets of the electric car.

The shut-off valve on the hose is opened.

What happens?

Result:

The car is moving.  
It is powered by the fuel cell.



# THE FUEL CELL CAR, THE 'CLEAN' DRIVE SYSTEM

AED 7.4

Conclusion:

By supplying hydrogen, electrochemical energy is converted into electrical energy in the fuel cell.

In the generator, this electrical energy is converted into mechanical energy.

Notes:

The surface must be as smooth as possible so that the car has as little rolling resistance as possible.

Of course, other consumers can also be connected to the fuel cell. However, please note that the small surface area of the membrane means that the cell's output is relatively low:

Output voltage:	max. 0,6 V (DC)
Output current:	max. 360 mA
Power:	max. 210 mW

**Practical information:**

*In practice, fuel cells with larger surfaces are therefore used. Several of these cells are then connected in series, and this unit is called a 'stack'. Stacks are already being used to power cars, buses, forklifts and many other vehicles and devices.*

**Information on resolving technical issues:**

**If there is sufficient hydrogen but the appliance is not running, please check the following solutions:**

*Remove the small cap from the short tube on the 'blue' side of the cell and put it back on shortly afterwards. This allows impure gases to be removed from the membrane. This should improve the cell's performance again.*