

# fuel cell X7

hydrogen powered car

**WARNING!**

This kit should only be used by persons 10 years old or older, and only under the supervision of adults who have familiarized themselves with the safety measures described in the kit. Keep small children and animals away from the experiments, as it contains small parts that could be swallowed.

**CAUTION!**

The fuel cell generates gases that are very easily ignited. Read the instructions and safety information before use and have them ready for reference.

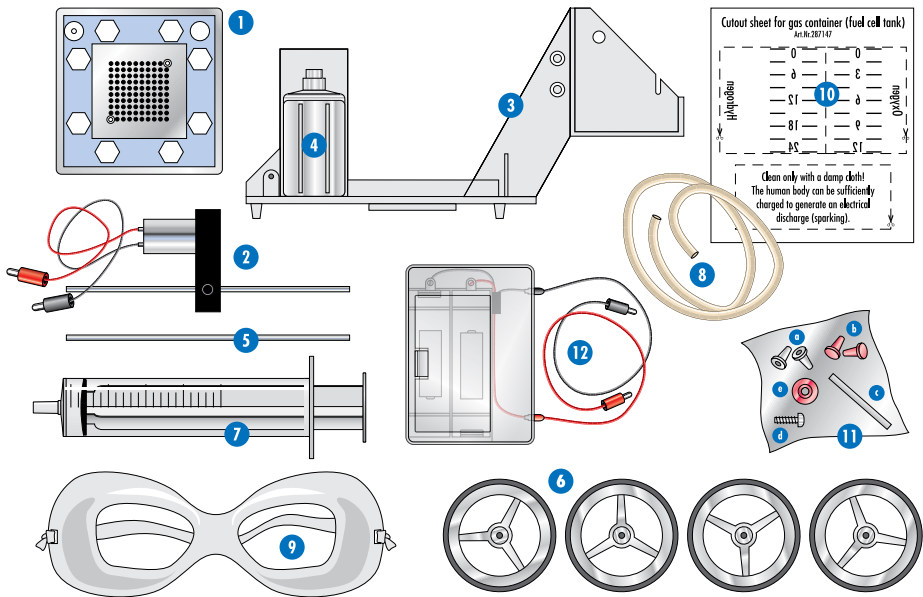
# Introduction

A **fuel cell** is a device that uses chemicals to create electricity. You can think of a fuel cell like a battery, which is a device that converts chemical energy into electrical energy, but there are two important differences: a fuel cell consumes the reacting chemicals, while a battery does not. Also, a fuel cell does not use up the electrodes (or metal conductors inside them), while a battery does. This means that a fuel cell can be used continuously for a longer period of time

than a battery, as long as the chemicals it uses are available.

With this kit, you will build a model car that runs on a hydrogen fuel cell. First, you will assemble the car. Then, you will use the fuel cell to split distilled water into hydrogen and oxygen gas, and store those gases in tanks on the car. Finally, you will connect the electric motor to the fuel cell, and the fuel cell will use the hydrogen and oxygen gas to make electricity to power the motor.

## Contents



- 1 Fuel cell, complete
- 2 Geared motor
- 3 Car chassis
- 4 Gas collector tanks
- 5 Axle
- 6 4 Wheels with tires
- 7 Syringe
- 8 Hose

- 9 Safety Goggles
- 10 Stick-on label
- 11 Bag of small parts:
  - a 2 Hose connectors (clear)
  - b 2 Hose plugs (red)
  - c 1 Syringe tip (white or red)
  - d 1 Screw (FZ 2.9x6)
  - e 1 Bushing (red)

- 12 Battery holder

You will also need:  
*Distilled water*  
*Philips head screwdriver*  
*Glue (optional)*  
*Scissors*  
*2 AA batteries*

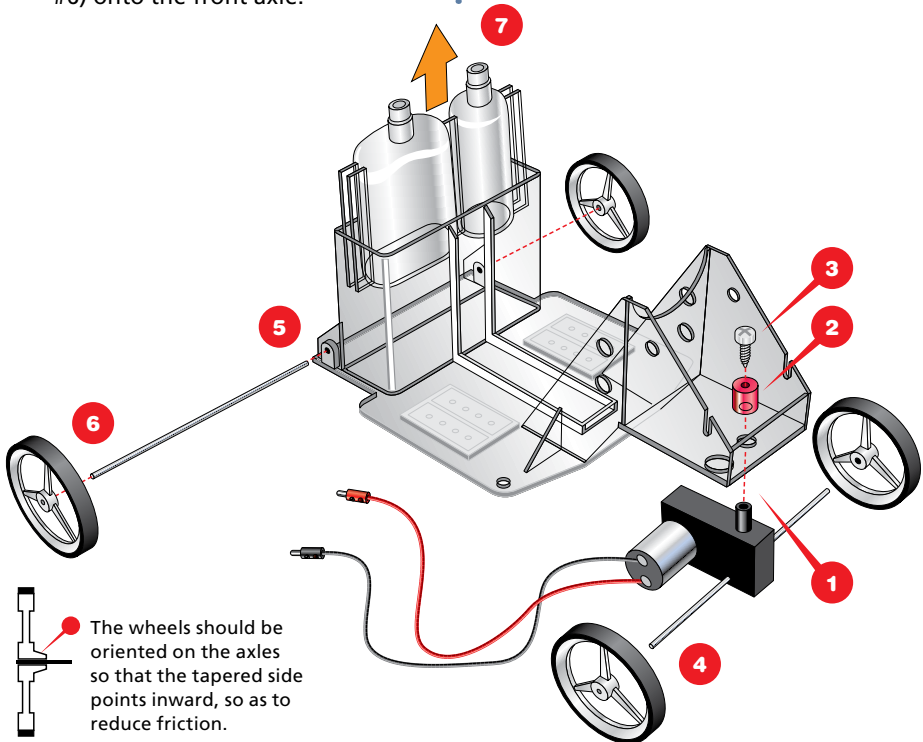
# Building Your Fuel Cell X7

Before you can run your Fuel Cell X7, you must assemble it. Follow these steps to assemble the car.

- 1 Find the **car chassis** (part #3) and the **geared motor** (part #2). Insert the peg on the geared motor into the small hole at the front of the chassis.
- 2 Slide the **red bushing** (part #11e) over the black peg.
- 3 With a philips head screwdriver, insert the **screw** (part #11d) through the bushing into the black peg.
- 4 Attach the **two front wheels** (part #6) onto the front axle.

**!** **Important!** Be careful that your finger or hand is not covering the outside hole of the wheel when you insert the axle, as the axle could slip through. Be careful not to bend the axle!

- 5 Slide the **rear axle** (part #5) through the holes in the back of the chassis.
- 6 Attach the **two back wheels** (part #6) onto the back axle, like you did in step 4.
- 7 Remove the **gas collector tank** (part #4) from the chassis for now.



# History of the Fuel Cell

In 1794, after having first developed the plate capacitor, the Italian physicist **Alessandro Volta** (1745-1827) started experimenting with the chemical production of electric current. He immersed a pair of zinc and copper rods in diluted sulfuric acid thus creating an electric voltage of approximately one volt. In his honor, electric voltage is indicated in units called volts.



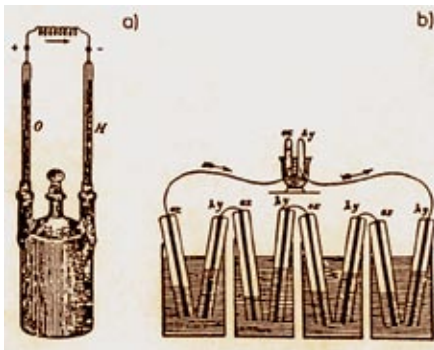
The English physicist **Sir William Robert Grove** (1811-1896, left) is thought to be the inventor of the fuel cell. As early as 1839, he demonstrated its basic mode of operation. He recognized that during the dissociation of water into hydrogen

and oxygen, a chemical reaction occurs which he described as "cold combustion." In his "gas battery," an arrangement of several platinum electrodes in sulfuric acid that were flushed with hydrogen and oxygen, he generated a voltage of about one volt. He also discovered that this reaction is reversible.

Because of technical difficulties — in particular, the lack of stability of the materials used at the time, but also because the development of alternating current generators — fuel cells were not developed into commonly used energy sources. In the late 1800's, **Wilhelm Oswald** (1853-1932) showed fuel cells to have a much higher efficiency than heat engines, but they were still not commercially developed. The work done by these early scientists paved the way for fuel cell research to this day.

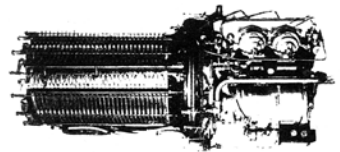
In the 1900's, many scientists all around the world researched and experimented with different types of fuel cells. Many of them successfully created small, efficient fuel cells in their labs, but scaling the cells up for practical applications proved impractical and too expensive.

In the mid-1900's, fuel cells began to be used in high-tech applications such as spacecraft and submarines. In 1939, **Francis Thomas Bacon** (1904-1992) developed an alkaline fuel cell that was later used by NASA for the Apollo spacecraft and is still used today in the Space Shuttle program.



a) Fuel cell circa 1839 and b) Grove's Gas battery

Hydrogen-oxygen cell used in Apollo space vehicles



Today, the promise of very efficient energy conversion makes fuel cells especially interesting in the context of protecting our environment, but much work remains before fuel cells can be widely used in everyday applications, such as automobiles.