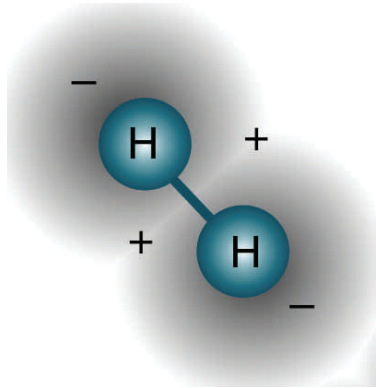


Hydrogen Fuel Cells and Wind

Electrolyze Water to Make Hydrogen for Energy

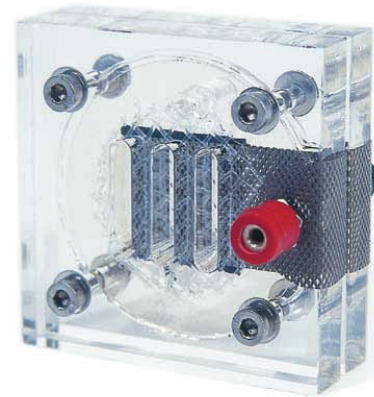
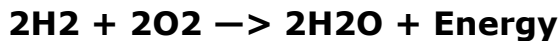


Hydrogen is the most abundant element in the universe, and it is also the element with the most energy per unit of weight! However, hydrogen gas does not exist naturally on earth—it is only found in compounds like water and all growing things. A Hydrogen Fuel Cell uses the energy in hydrogen and oxygen molecules to make electricity. It takes some energy to produce pure hydrogen because it requires bonds to be broken. The process of separating chemically bonded elements is called “electrolysis.”

The electrolysis of water (H₂O) produces hydrogen which we can use in fuel cells. Two molecules of water can be separated into oxygen (O₂) and two hydrogen molecules (2H₂).

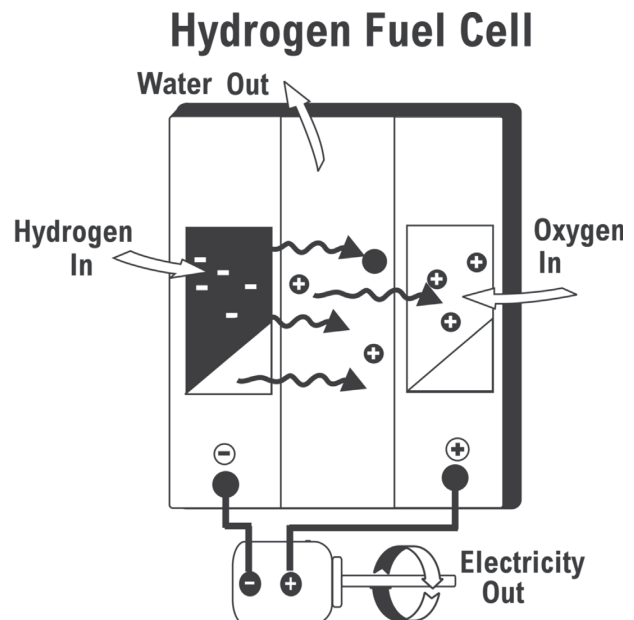


These fuel cells are known as “reversible fuel cells” because they can be used to electrolyze water (producing hydrogen and oxygen), and they can also be used to consume hydrogen and produce energy (electricity). So the reverse equation is also carried out in a fuel cell:



In this way, fuel cells serve a similar function to batteries, but don't confuse the two! A fuel cell consumes an outside reactant (H₂), which must be replenished. Batteries, on the other hand, store electrical energy within a closed system. When pure hydrogen is consumed in the fuel cell, the result is electricity and water—with none of the toxic emissions of other fuel sources.

The electricity created by fuel cells can be used in many applications. One of the most promising uses is in cars. Fuel cell cars have no emissions other than water, and therefore do not contribute to climate change. But beyond transportation, fuel cells could also be used for heating and power generation with no pollution!



Electrolyzing Water in the Fuel Cell using Wind Energy:

Remember that making hydrogen requires energy for breaking bonds. The advantage of hydrogen is that it can be stored and transported, unlike the energy produced by wind turbines or solar cells. Fortunately, we can use clean energy sources like wind and solar to produce the hydrogen—creating a clean, transportable source of electricity with no hazardous emissions!

Unfortunately, un-g geared PVC turbines will not be able to produce enough energy to electrolyze water. However, using the geared turbine and a good set of blades, it is easy to start pumping out hydrogen!



Your Fuel Cell came with an instruction booklet. It is a good idea to read through these instructions before you try to use your fuel cell. If you do not follow some simple guidelines, you could end up damaging or destroying your fuel cell.

1. **Use distilled water only!** Distilled water is very pure—it does not contain minerals found in regular bottled water or tap water. Fuel cells use very sensitive particles such as carbon supported platinum, and the impurities in non-distilled water can damage these particles.
2. **Correct polarity is key!** Polarity refers to which lead is positively charged and which is negatively charged. You may have noticed that batteries always have (+) and (-) sides. The same is true with electric motors, solar cells, fuel cells, etc. You will need to test the polarity using a multimeter. Make sure the wires from the multimeter are correctly installed as shown in the picture (black wire goes in COM port). Connect your turbine to the multimeter and turn on a fan to get a voltage reading. If your voltage reading is positive, the lead connected to the red multimeter wire comes from the positive terminal. If the voltage reading is negative, the lead connected to the black multimeter wire comes from the positive terminal. You may want to reverse your leads so that the red multimeter wire is connected to the positive terminal.



When you connect your wind turbine to the fuel cell to electrolyze water, the positive lead should go to the Oxygen (O₂) side, and the negative lead should go to the Hydrogen (H₂) side. The oxygen side of your fuel cell should have a red input port, so remember—red is positive, black is negative.

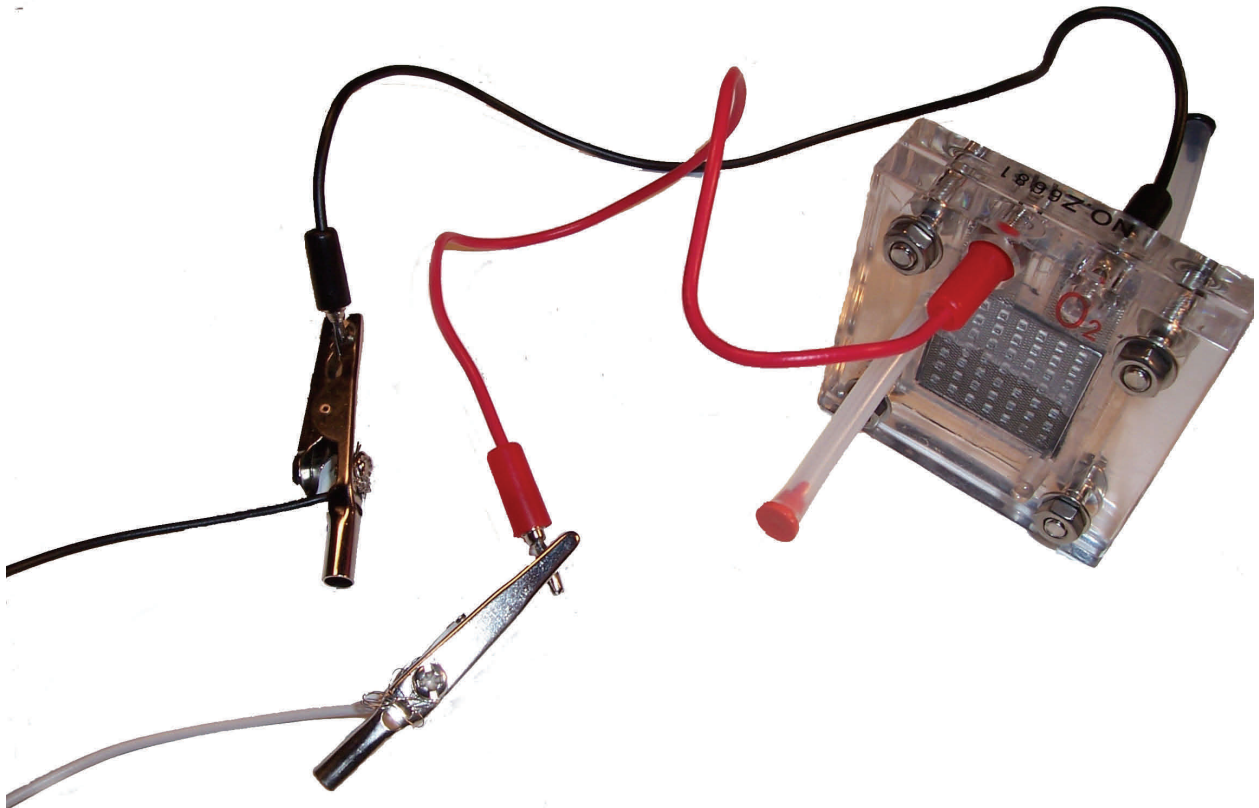
3. **Hydrate your fuel cell!** This is important to do before you try to produce hydrogen. Your instructions will tell you how to hydrate the cell, but remember that you must do this from the Oxygen (O₂) side!

Have you taken these steps?

- Read Instructions
- Check polarity (+,-) of your wind turbine wires
- Set up your fuel cell as described by instruction booklet
- Hydrate your fuel cell
- Attach positive wire to the Oxygen Side, negative wire to Hydrogen side
- Put distilled water in the fuel cell cylinders

Now you should be ready to start making some hydrogen!

Give your wind turbine some wind and it will start creating the electricity needed for electrolysis in the fuel cell. Before long, you should see a bubble of hydrogen gas forming. Oxygen gas will also form, but there will be twice as much hydrogen as oxygen. Do you know why there is more hydrogen? Once you have a good amount of hydrogen gas, unplug the wind turbine from the fuel cell and plug the fuel cell into some kind of load—lightbulbs, electric motors, water pump, or a fuel cell car!



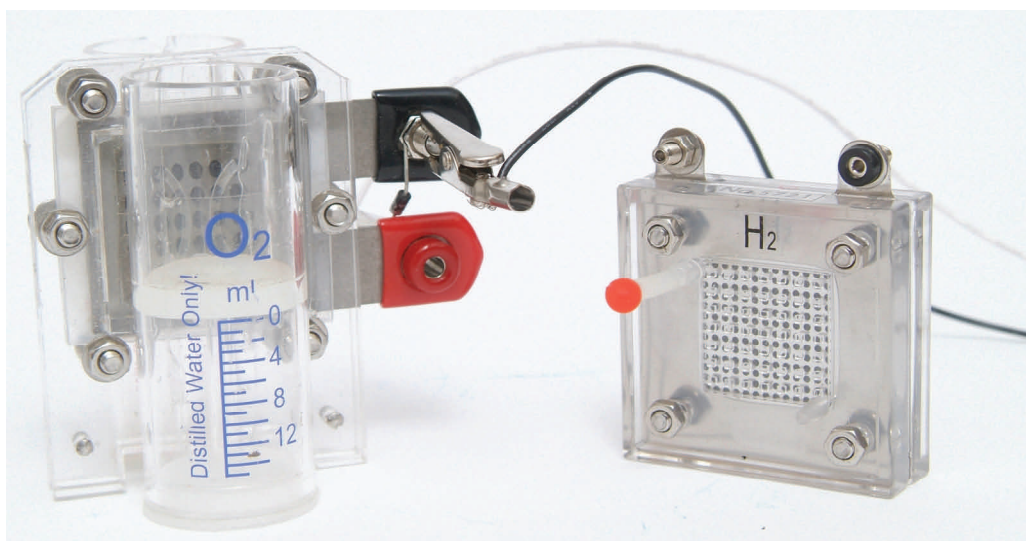
Connecting wind turbine leads to your fuel cell

By using your PVC wind turbine to create hydrogen and power a fuel cell, you have learned a lot about renewable energy! Hydrogen is one of the most promising energy carriers for the future. It is a high efficiency fuel with no pollutants that can be used for many applications.

The goal of the U.S. Department of Energy's Hydrogen Program is for hydrogen to produce ten percent of our total energy demand by the early 2030. Hydrogen can reduce our dependence on foreign oil and provide clean, renewable energy for the future.



Fuel Cell Car—the future of transportation?



For More information:

<http://www.need.org/>

<http://www.fuelcelledu.com/>

<http://www1.eere.energy.gov/hydrogenandfuelcells/>