

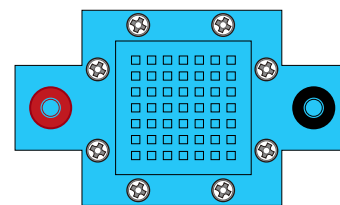
Product Ref No.: (FCSU-012)

## Specifications:

- High performance PEM fuel cell specifications:
- Dimensions (w x h x d): 32mm x 32mm x 10mm
  - Total Weight: 27.3grams
  - Output Power: 270mW
  - Output Voltage: 0.6V (DC)
  - Output Current: 0.45A
  - Color: Blue

## What is included:

- PEM Fuel cell
- ## What you need:
- PEM Electrolyzer Fuel Cell
  - Pins, Tubing
  - 2 x banana cables/ Connecting leads
  - Syringe
  - Clincher
  - Battery pack or solar panel
  - Distilled water
  - Gas containers



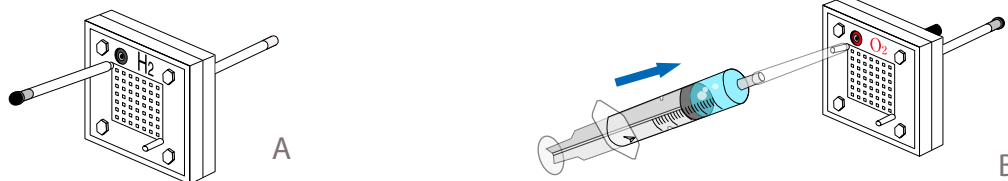
## Fuel Cell Experimentation:

Before applying a load to the fuel cell, you must first create the hydrogen and oxygen gasses needed by the fuel cell for the conversion of chemical energy into electrical energy. This can be performed by using Horizon PEM electrolyzers and outer/inner gas containers to create and capture the hydrogen and oxygen gasses. These inner/outer containers are made primarily for educational demonstration, and you may also use small balloons as in the H-racer or small syringes to capture the gasses.

## PEM Electrolyzer- User Directions

### Preparation of the Electrolyzer and Solar/Battery Powered Hydrogen Production

1. Place the Electrolyzer onto a flat surface. Cut 2 x 4cm length pieces of rubber tube and insert a black pin into the end of one tube. Place the tube with the black pin into the top pin on the hydrogen side (with black terminal). Place the other tube firmly onto the top input nozzle on the oxygen side (see A).



2. Fill the syringe with DISTILLED water. On the red (oxygen) side of the electrolyzer, connect the syringe to the uncapped tube. Fill the electrolyzer until water begins to flow out of the tube. Place a red plug into the short tube located on the Oxygen side of electrolyzer. Let settle for 3 min (see B).

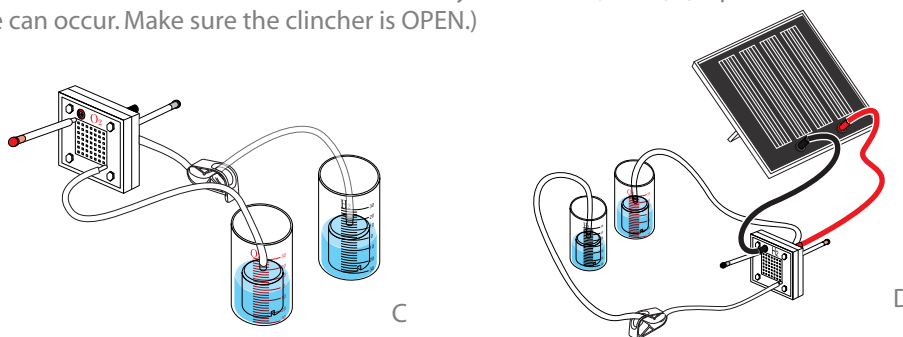
3. Place the outer water/gas containers onto a flat surface. Fill with distilled water up to the "0" line.

4. Place inner containers into outer cylinders minding that the gaps are not blocked by inner plastic rims. Make sure the water is still level to the "0" line. If not, remove some water with the syringe so that water level is at "0" line. Cut out two 20cm lengths of tubing.

5. Place one tube through the holes on the white clincher, with the clincher 4 cm from the end of the tube. Connect the tubes to the top nozzles on the inner containers. If the tubing is connected to the inner cylinders lastly there will be no air trapped inside the inner containers.

6. Connect the other end of one of the tubes to the bottom end of the black hydrogen side of the electrolyzer. Connect the end of the other tube to the bottom end of the red oxygen side of the electrolyzer (see C).

7. Connect the electrolyzer to the solar panel using the corresponding cables and expose to direct sunlight. You can also use a Horizon battery pack and two AA batteries to connect to the electrolyzer as well (see D). (Important: make sure connections are correct or permanent damage can occur. Make sure the clincher is OPEN.)



8. If the solar panel is placed in sufficiently strong sunlight, or battery pack is switched to the "On" position the system will now start to produce oxygen and hydrogen in the respective cylinders. When bubbles begin to surface in the hydrogen cylinder the cycle is complete. Disconnect the solar panel or battery pack from the electrolyzer.

Procedure for repeated gas production: Disconnect the small plugs from the tubes connected to the nozzles on the electrolyzer fuel cell. This will allow water into the inner cylinders to replace the gasses and reset water levels to "0" line. Re-insert the plugs into the tubes and repeat electrolysis again.

\* The attached gold leads included with the PEM Electrolyzer and PEM fuel cells may be inserted into red/black terminals of the fuel cells if attaching other devices such as solar panels and small wind turbines using crocodile clip type leads/ cables. These may be also used to attach various loads to PEM fuel cells. We alternately provide 1 set of red/black 2mm banana plug leads/cables with each PEM electrolyzer and fuel cell that are designed to connect to Horizon solar panels and educational wind turbines.

#### Important:

- It is highly recommended to place the PEM electrolyzer and PEM fuel cells inside an air-tight plastic bag, such as a "Ziploc Bag." This will protect it when you are not using the kit.
- The positive and negative poles of the PEM electrolyzer fuel cell must be correctly connected to the power supply or damage may result.
- The membranes in the PEM electrolyzer fuel cell are to be used only when they are hydrated. Inject water only into the positive (oxygen) side of electrolyzer and allow to soak for 3 minutes. The membranes will be damaged if connected to a solar panel or power supply when dry.
- It is highly recommended to use 3 W solar panel with 1A current or 2 new AA alkaline batteries with 1.5V as a power supply.

#### BUILDING AN APPLICATION FOR THE PEM FUEL CELL

Several different types of devices can be commonly powered by the fuel cell such as small motors, LED lights, small water pumps, and other small electric devices requiring small amounts of power. Use your imagination in engineering new devices and applications using the fuel cell as its power system.

#### USING FUEL CELLS TO CONVERT HYDROGEN TO ELECTRICITY

##### Preparation of the Fuel Cell System

##### Using a PEM Fuel Cell to Power a load

1. Clench the tube connecting the hydrogen side of the electrolyzer and hydrogen cylinder so that none of the hydrogen in the cylinder from the last experiment can escape using a Horizon white clincher or you can alternatively use a common clothes pin.
2. Next disconnect the tube from the PEM electrolyzer and connect it to the lower nozzle on the PEM fuel cell. This should be done while keeping the tube clinched so that the gasses stored in the hydrogen cylinder do not escape while connecting the the PEM fuel cell and preparing the fuel cell system.
3. After properly connected, ensure that the small 2cm tube with pin is placed securely on the other nozzle located on the PEM fuel cell.
4. Connect the load to the PEM fuel cell using the cables provided with the fuel cell. Make sure to connect the black wire with the black terminals and red wire with the red terminals.
5. Open the clinching device (or remove clothes pin) located on tubing connecting fuel cell to the hydrogen supply. You should see the load begin to operate and use the electricity produced by the fuel cell. The load should begin to consume the hydrogen/oxygen fuels stored in the cylinders if there is sufficient levels of gasses available. If not, try gently squeezing the tubing to allow some of the gas to move into the fuel cell from the hydrogen storage container. As the load uses electricity the fuel cell will consume hydrogen from the cylinder and you will see the water level reflect the changes in amount of gases consumed.

