**Understanding Electrolysis Investigation**

**Learning Objectives:**

*In this investigation you will learn:*

* Quantitative observations of electrolysis
* Breaking up of molecules
* Catalysts
* Electrolyzers
* Faraday’s law of electrolysis
* Identification of hydrogen and oxygen

In this investigation you will examine electrolysis in a **quantitative** manner. This means you will observe closely what is going on in the **electrolyzer** and will offer some suggestions as to what is happening.

***Focus Question: What is an electrolyzer?***

**Materials:**

Solar panel or hand generator

2 patch cords

Reversible fuel cell, used here as an electrolyzer

Load measurement box

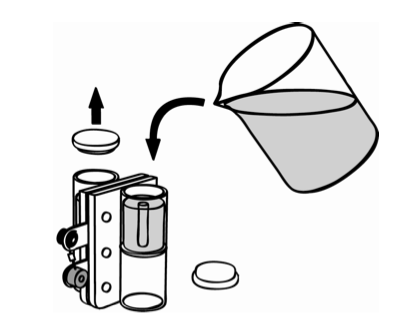
Distilled water

Stopwatch

**Procedure:**

1. Place the fuel cell upside down (numbers facing down) on a flat surface.
2. Remove the stoppers.
3. Pour distilled water into both storage cylinders until the water reaches the tops of the small tubes in the center of the cylinders.
4. Tap the fuel cell lightly to help water flow into the area surrounding the membrane and metal current-collecting plates.
5. Add more water until it starts to overflow into the tubes in the small cylinders in the center.
6. Place the stoppers back onto the cylinders. Make sure no air is trapped inside the small cylinders.

***See diagram below.***



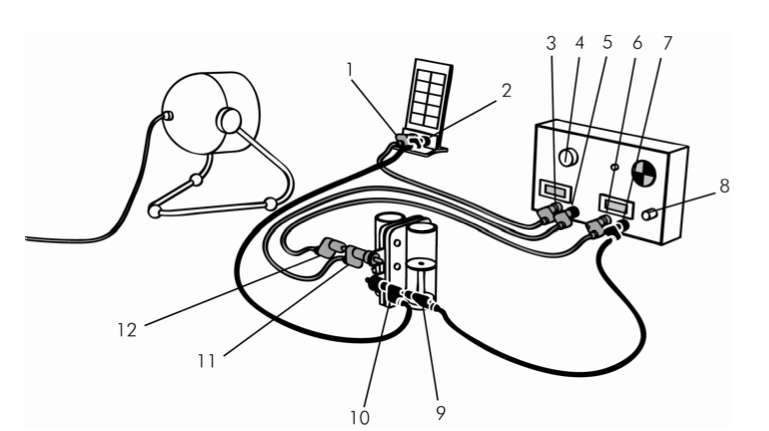
1. Turn the fuel cell right side up.
2. Watch the top of the small tubes for 30 seconds. Does any water come out? Write down your observation.

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**Read these steps carefully. Use the diagram to help you.**

1. Connect the red (positive) terminal of the solar panel (1) to the red (positive) terminal of the ammeter (3).
2. Connect the black (negative) terminal of the solar panel (2) to the black (negative) terminal of the reversible fuel cell (10).
3. Connect the red (positive) terminal of the reversible fuel cell (11) with the black (negative) terminal of the ammeter (5).
4. Connect the black (negative) terminal of the reversible fuel cell (9) with the black (negative) terminal (7) of the voltmeter.
5. Connect the red (positive) terminal of the reversible fuel cell (12) with the red (positive) terminal of the voltmeter (6).



1. Set the LOAD knob (4) to SHORT CIRCUIT.
2. Push the ON/OFF button (8).
3. Align the solar panel with the light source.
4. Turn on the light.
5. Position the solar panel and light so that the current is 150 mA or more.
6. Watch the top of the small tubes for 30 seconds. Does any water come out? What do you think pushes the water out? Write down your observations and ideas below.

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Continue observing and every 2 minutes record the amount of gas collected in each storage cylinder. Or you may REPLACE the solar cell with the hand generator and turn it to create a continuous source of electricity for the next 10 minutes. (Keep your test fair by turning the generator evenly for 10 minutes.)

|  |  |  |
| --- | --- | --- |
| **Time from start (minutes)** | **Cathode (black) gas volume (mL)** | **Anode (red) gas volume (mL)** |
| **0** |  |  |
| **2** |  |  |
| **4** |  |  |
| **6** |  |  |
| **8** |  |  |
| **10** |  |  |

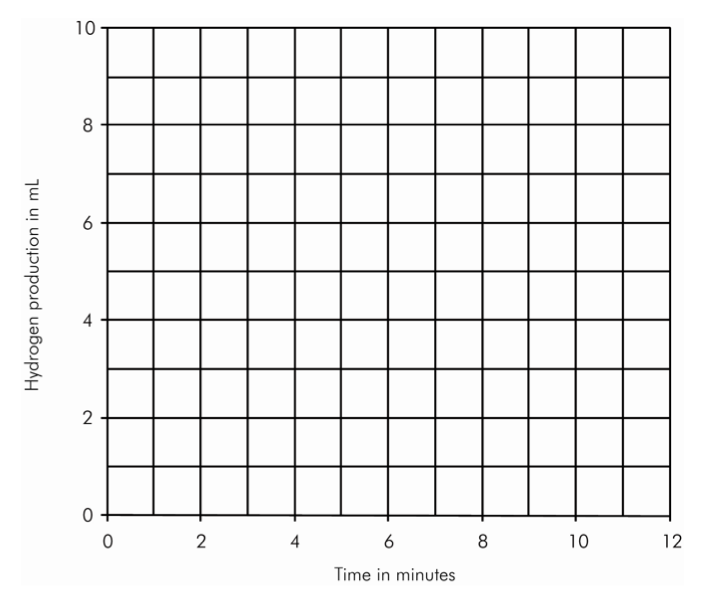
1. When 10 mL of gas is collected in one cylinder, have the time recorded and the amount of gas in the other cylinder. This completes the table.
2. Let the electrolyzer continue working until **all** the water has moved into the upper portion of one of the cylinders. (With optimum lighting, it should take 10-15 minutes to displace all the water into the upper hydrogen cylinder.)

**Disassemble and clean up all equipment and materials.**

**Making Meaning Questions** – *Answer the following questions in complete sentences.*

1. Why is it important to ensure there are no large bubbles of air remaining when we fill the gas storage cylinders with water?
2. Using the information provided by the labels on the gas storage cylinders, which electrode is attached to which cylinder?
3. Is gas produced at similar rates at each electrode? What evidence do you have of this?
4. What simple ratio can you use for gas production?
5. Do you have any evidence that the labels on the cylinders are placed on the correct cylinders?
6. Looking at the scientific formula for water, H20, what do you think happened in this investigation?
7. Use the data from your table to create a graph. Include a **title**.

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1. How much gas would be produced if you ran your electrolyzer for one hour? (*Hint: Extrapolate your data*).
2. How long would it take for you to collect one liter of cathode gas? Of anode gas?
3. Using the results you obtained from this investigation, what is an **electrolyzer** and what does it do?