

# ASSEMBLY GUIDE

## Fuel Cell Science Education Kit



Model No.: FCJJ-34

### Warning

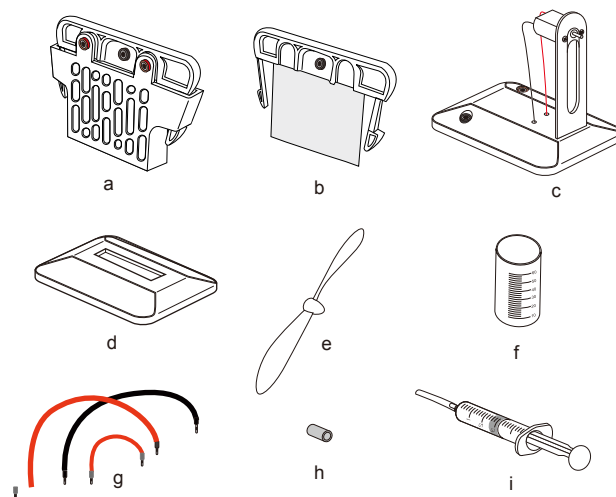
To avoid the risk of property damage, serious injury or death:

1. Read carefully and fully understand the instructions before assembling this kit.
2. Keep this kit out of reach of small children and animals because it contains small parts that could be swallowed.
3. This product is intended only for use by persons aged 12 years and older, and only under the supervision of an adult who has read and understood the instructions provided in this user manual.

4. You may use tools to assemble this kit, however, extra care should be taken to avoid injury.
5. Some parts are small and fragile. Please be careful when handling and connecting parts to avoid breakage. Handle all parts and components with care.
6. Do not attempt to use any part, item or components provided in this product for any purposes other than for its intended use.
7. Do not attempt to disassemble any parts, items or component in this kit.

### List of Components

- a. Salt water fuel cell
- b. Salt water fuel cell anode plate
- c. Fan module
- d. Salt water fuel cell base
- e. Fan blade
- f. Graduated container
- g. Wires (two 20cm long & one of 10 cm)
- h. Fan blades adapter
- i. Syringe and syringe tubing



- You will also need the following items (not included in this kit):
- Purified or distilled hot water at a temperature at or above 90°C
  - Salt (food grade) 50g
  - Weighing scale/balance

### IMPORTANT NOTES:

1. To avoid injury please take care with the hot water.
2. Wearing waterproof gloves and glasses is strongly recommended.
3. To avoid injury please take care with the fan.
4. To maximize the kit's longevity, clean the anode plate after each use
5. Store the anode plate in a clean, dry place.

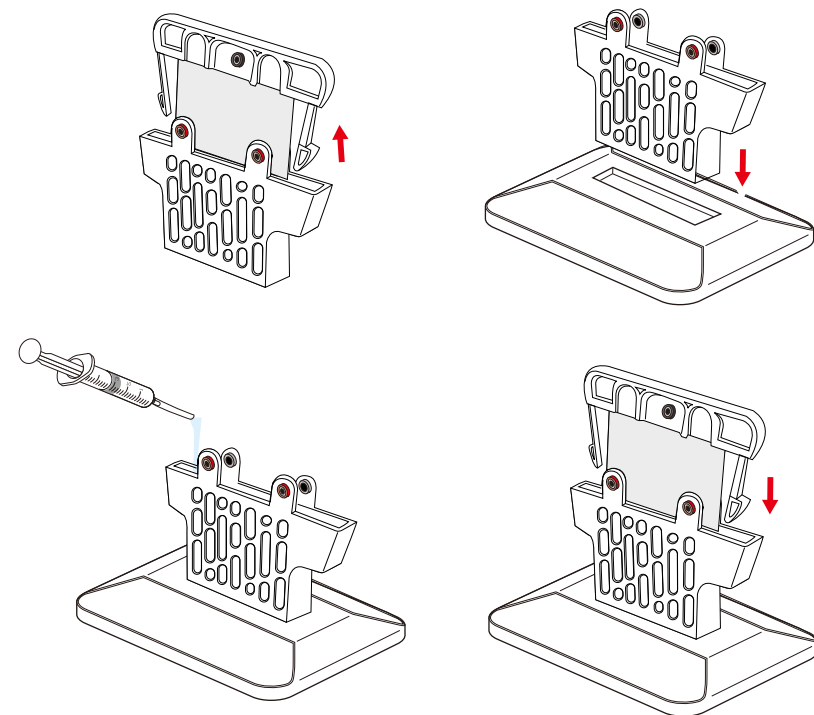
### Preparing the saltwater solution:

1. Weigh 15 mg of salt using the scale. Put the salt in the graduated container and add 25ml of hot water. The water temperature should be around 90°C (363 K).
2. Mix the container's contents with a spoon until the salt has entirely dissolved into the water. Sometimes a small part of the salt stays in a solid state.

### Experiment 1 : Create electricity from saltwater

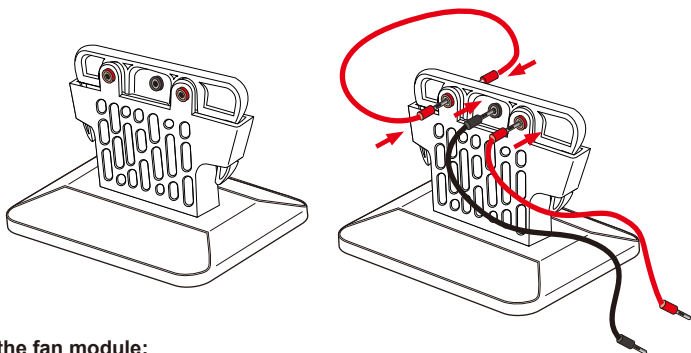
#### Prepare the fuel cell:

- a. Take the salt water fuel cell out of the packaging.
- b. Note that the blue plastic top of the saltwater fuel cell plate extends below the lip of the saltwater fuel cell tank. Squeeze both these blue sections at the same time to remove the SWFC plate from the SWFC tank.
- c. Insert the fuel cell cathode into the slot in the base of the SWFC tank.
- d. With the syringe, suck up some of the saltwater solution and transfer it to the SWFC tank until the tank is about ¾ of the way full (above 15mL).
- e. Take the SWFC plate and clip it into the SWFC tank as shown below.

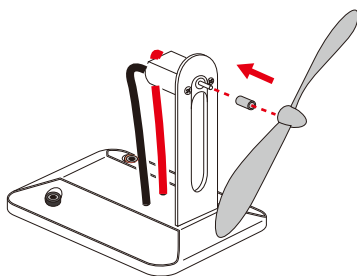


**Connect the wires to the fuel cell:**

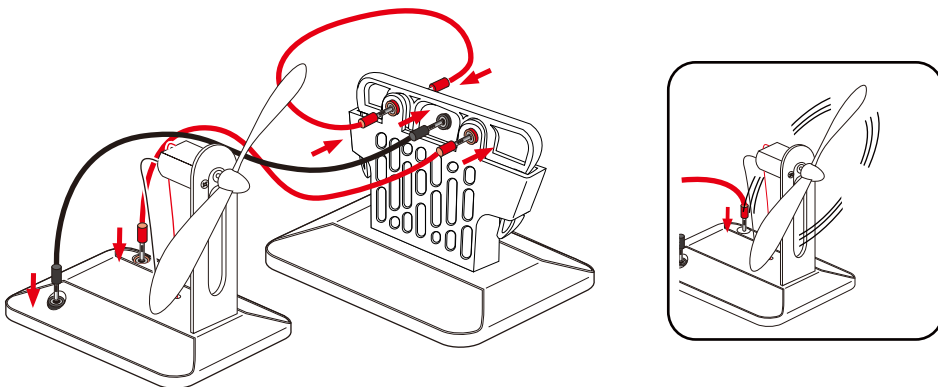
- Place the fuel cell in front of you so three plugs are facing you.
- Connect the one of the red wires to the lefthand red plug in the front. Connect the other end to the lefthand plug on the other side of the cell.
- Connect the black wire to the central plug and remaining red wire to the righthand plug in the front.

**Prepare the fan module:**

Insert the adapter into the fan's motor axis. Push the fan blade onto the adapter and ensure the connection is tight.

**Power the fan with the salt water fuel cell:**

- Connect the loose end of the long black to the black socket on the fan module, and the loose end of the long red wire to the red socket on the fan module.
- You will notice that the fan will start to rotate as soon as the wires are connected to the fan module. The salt water fuel cell provides a minimum of 4 hours of power.

**Experiment 2: Using different salt concentrations**

Follow the "preparing the fuel cell" instructions for Experiment 1 but this time connect a multimeter rather than the fan. Measure the output, current and voltage of the fuel cell for the different salt concentrations as in the table below. Remember to clean the fuel tank every time you change the salt water. Record your results.

mass [g]	Salt concentration [%]	Current [A] / Voltage [V]
2	4%	
5	9%	
10	19%	
15	28%	
20	38%	

**Experiment 3: Using different water temperatures**

Follow the directions for Experiment 2 but this time, add 15g of salt to hot water (90°C) and allow the mixture to dissolve. Once that's done, heat the water in order to reach the different temperatures shown below and then measure the output current with a voltmeter. Remember to clean the fuel tank each time you change the saltwater. Record your results.

Solution temperature [°C]	Current [A] / Voltage [V]
25	
45	
65	
80	
90	

**Experiment 4: Using different fuel volume**

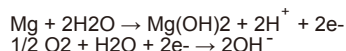
Prepare the saltwater as in experiment 1 but this time connect a chronometer to measure the running time with different concentrations. Record your results.

Volume poured in the fuel tank [mL]	% of fuel tank volume	Current [A] / Voltage [V]
5	25%	
7	35%	
10	50%	
12	60%	
15	75%	

## FAQ

### 1. What is a salt water fuel cell? How does it work?

This kind of fuel cell works with air and with a plate made with magnesium. The electricity is generated by two chemical reactions which occur at two different places within the cell. At the plate, also called the 'anode', the water reacts with the magnesium and creates hydrogen ions (protons), magnesium hydroxide and generates two free electrons. On the other part of the cell (the 'cathode'), the oxygen contained in the air passes through the cell walls and reacts with the water, creating hydroxide ions. This reaction is possible only if there are additional electrons. So, during the reaction, the free protons generated on the anode are attracted by the cathode because of the potential difference. If the cell is linked to an electrical circuit, the free electrons will pass through it in order to reach the cathode and let the second reaction happen. You can find the two half redox equations below.



The salt in the water is used as a catalyst. In other words, the salt accelerates the reaction between Mg and water.

### 2. Is it possible to increase the output of the salt water fuel cell? And if so, then how?

Yes. It is possible to increase the output of the salt water fuel cell. You could increase the anode and cathode size to increase the output power. You could try to increase the salt water solution temperature or you could increase the salt concentration to get a higher fuel cell output.

### 3. What is the optimum salt solution concentration for generating power?

You can do experiment 2 – try out different salt concentrations to find the answer.

### 4. What is the anode metal plate made of?

The metal plate is made of magnesium (Mg).

### 5. What are the specifications for the fuel cell?

Normally the output voltage is 1.2V and the current is 200mA.

### 6. Where can I buy more magnesium plates?

We can provide magnesium plates. Please contact [sales@horizonfuelcell.com](mailto:sales@horizonfuelcell.com) for more information.

### 7. Are there any other energy related educational products? Where can I buy them?

We provide many types of energy education products. They are related to solar power, hydrogen power, chemical power, mechanical power, wind power, thermal power etc. For more sales information, please contact [sales@horizonfuelcell.com](mailto:sales@horizonfuelcell.com).

### 8. How to optimize fuel cell performance?

After each use, clean the fuel cell using clean water. Ensure there is no remaining salt inside. Store the anode plate and salt water tank separately in a clean dry place.

### 9. What are the white particles on the anode metal plate?

They are the magnesium hydroxide and sodium chloride – a result of the reaction between the salt water and the magnesium plate.

## TROUBLESHOOTING

I put the anode plate into the tank but there is no electricity being generated.

### Solutions:

1. Make sure all the connections are in place.
2. Try to clean the magnesium plate. If it still does not work, clean the metal parts.
3. Exchange the magnesium plate for a new one.
4. Make sure there is some salt water solution in the salt water tank.



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