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# GEO Salt Water / Solar Powered Robot



Solar Powered

GREEN SCIENCE

This product runs on green energy that does not cause harm to the environment. Use either solar energy or salt water battery to power the robot car. Guide your kids while they assemble the robot car with their own hands. Give the gift that fosters curiosity and encourages scientific learning.

User Manual

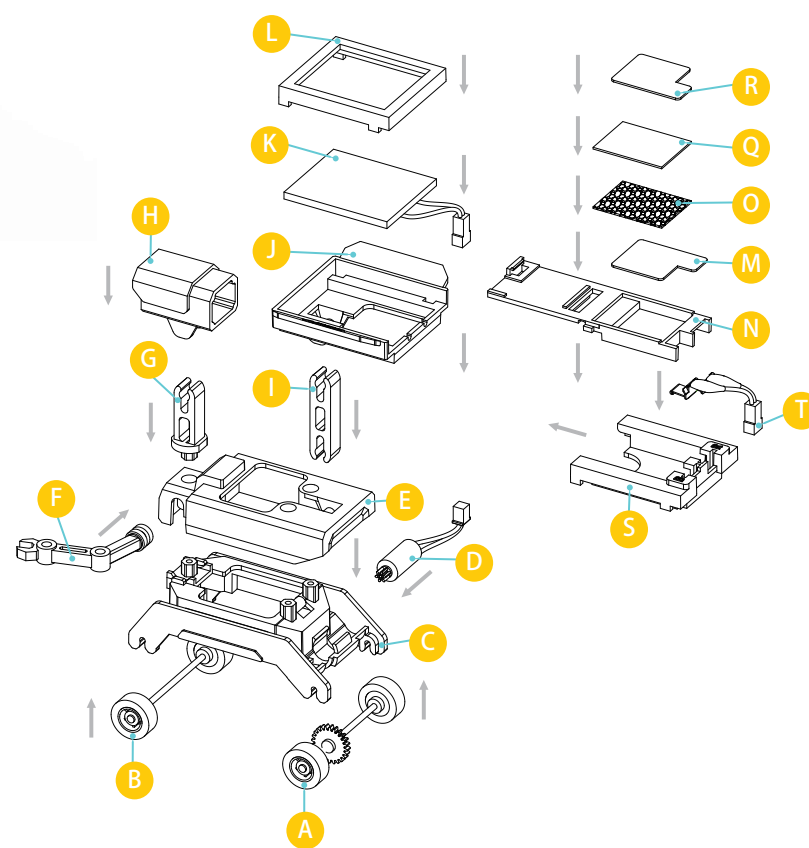
**Warning:**

1. CHOKING HAZARD - The product contains small pieces. Keep it away from children under 3.
2. For your safety, do not put any parts of this product in contact with AC power.
3. To avoid accidents, do not put your finger or hair into the product.

This product is recommended for children over 8 years of age, parents should read the manual carefully and guide their kids while they playing this product.

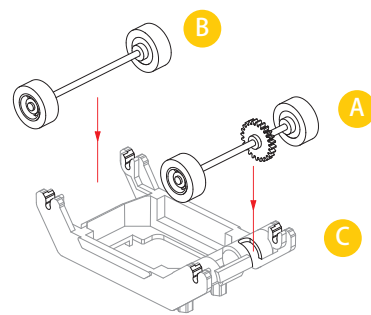
**WARNING:**  
WARNING: CHOKING HAZARD Small parts.  
Not for children under 3 years old.

## Assembly Instructions

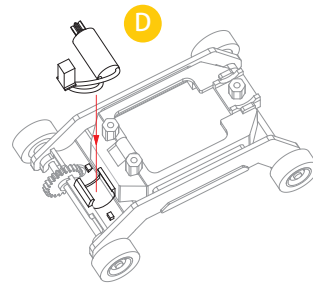


1. Install the front & back wheels on the chassis, match the gear with the notch on the chassis as shown.

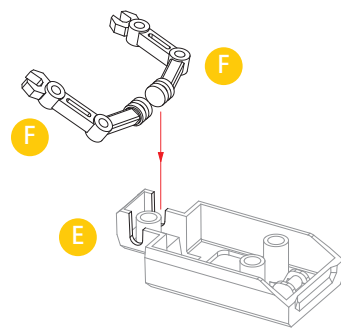
2. Mount the motor on the chassis as shown, make sure the motor is secured between the two bumps, and the gears are lined up with one another.



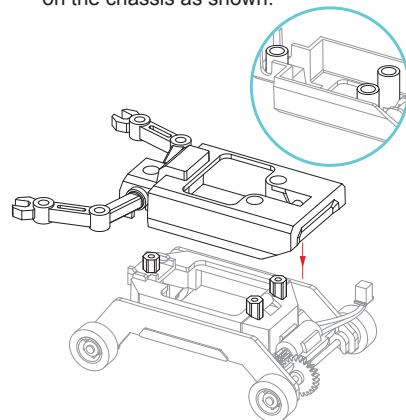
3. Install the two arms on the back cover.



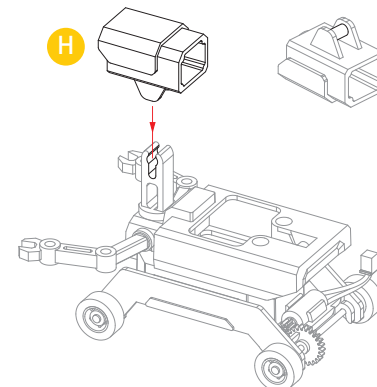
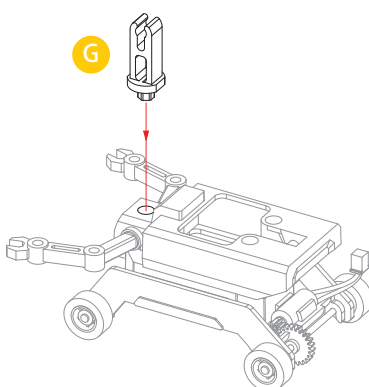
4. Install the finished component (step3) on the chassis as shown.



5. Install the neck for the head on the back cover.

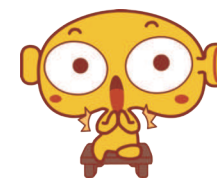
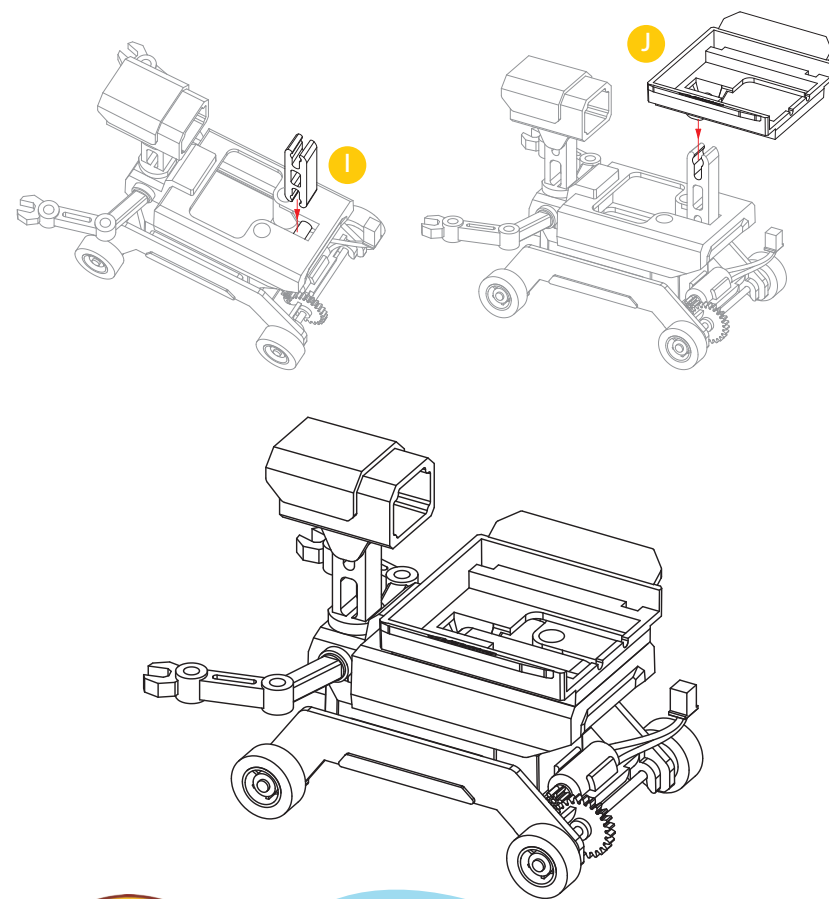


6. Place the head atop the neck. When a click is heard the head will be securely placed on to swivel up and down.



7. Install the connection bar on the back cover as shown. A click must be heard to ensure that it is fastened.

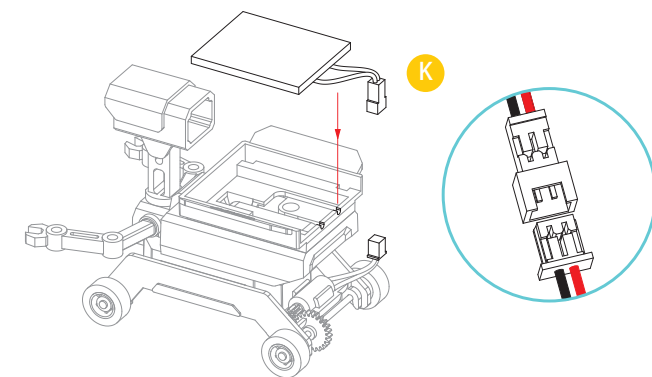
8. Install the support case on the connection bar as shown.



Good Job! We are almost there!

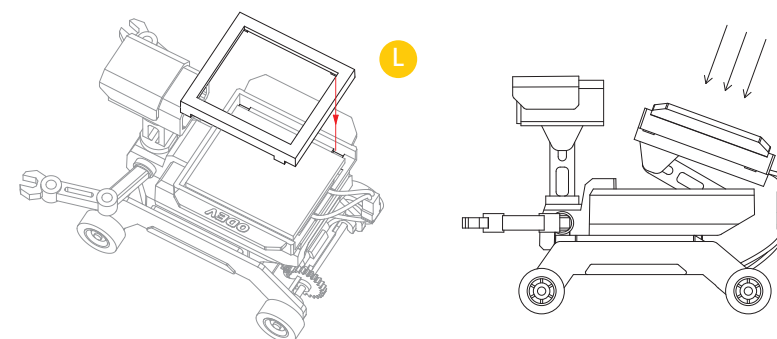
## Solar Panel Installation & Use

1. Remove the thin plastic solar panel film before installing and wipe off any smudges after finished. Place the solar panel atop the support case, and place the two solar panel wires into the two designated slots. After connecting the solar panel wire with the motor wire as shown. (Note: match the color of wires, red to red/black to black-do not plug forcibly. Please ask for parents' help if you have trouble plugging in the connectors.)



2. Put on the solar panel cover frame as shown. A click should be heard to ensure that it is locked in place and the solar panel is prevented from moving. (Do not squeeze the wires.)

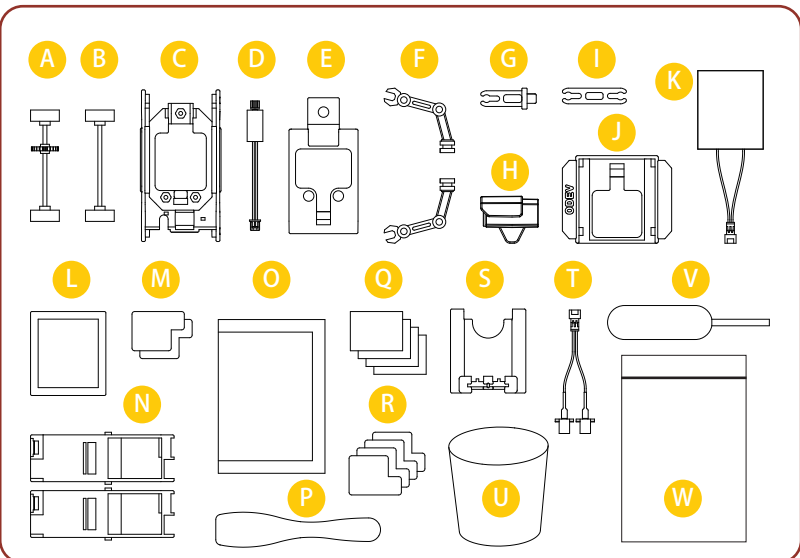
3. Take the robot outdoors, and place it on a smooth and flat surface in an open area. For best results, place the robot under direct sunlight. Please note that the robot is faster under brighter sunlight conditions.



**Tips:**

1. Please read the instructions on the manual carefully before assembling.
2. Please identify the parts before assembling.
3. Parental guidance is recommended.
4. This product contains small parts, do not allow kids to put them in mouth.
5. Do not use the product if any part of this product has been damaged or deformed.
6. Do not place the motor in water as it may damage the product or cause injury.
7. The robot car only runs on one type of energy (salt water battery or solar power) at a time.
8. Do not pull or fold the wires as it may damage the wires.
9. The battery box may expand even after use due to the continuous chemical reaction inside. To prevent this please follow the instructions on how to properly disassemble and clean the battery box.
10. Please keep this manual for future reference.

## Parts List



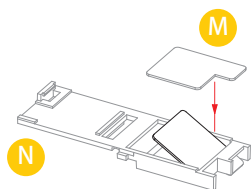
<b>A</b> back wheels (with gear)	1pc	<b>M</b> copper plate (yellow)	2pc
<b>B</b> front wheels	1pc	<b>N</b> battery case	2pc
<b>C</b> chassis	1pc	<b>O</b> activated carbon	1pc
<b>D</b> motor	1pc	<b>P</b> spoon	1pc
<b>E</b> back cover	1pc	<b>Q</b> absorbent paper	4pc
<b>F</b> arm	2pc	<b>R</b> magnesium plate (silver color)	4pc
<b>G</b> neck	1pc	<b>S</b> chemical reaction box	1pc
<b>H</b> head	1pc	<b>T</b> wire plates	1pc
<b>I</b> connection bar	1pc	<b>U</b> measuring cup	1pc
<b>J</b> support case	1pc	<b>V</b> dropper	1pc
<b>K</b> solar panel	1pc	<b>W</b> zipper bag (for activated carbon)	1pc
<b>L</b> solar panel cover frame	1pc		

## Salt Water Battery Installation & Use

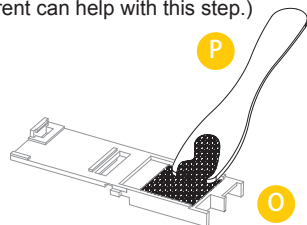


**Friendly Reminder:** Before starting the installation, use paper to cover your table to keep the working area clean.

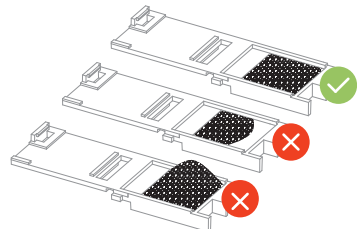
1. Insert one copper plate (yellow) in the battery case as shown.



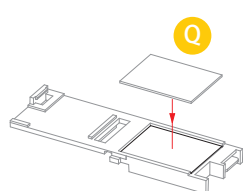
2. Carefully open the bag of activated carbon, use the spoon to pour an appropriate amount of activated carbon into the battery case as shown. Place the remaining activated carbon in the designated bag (W) provided. Please be sure to push out as much air as possible then zip tight the bag. (Parent can help with this step.)



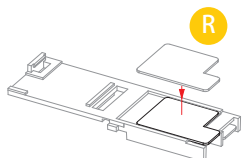
3. **Press down and smooth** the activated carbon, make sure the activated carbon evenly covers the surface as shown. Do not overfill.



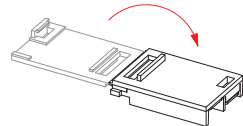
4. Place one absorbent paper on top of the activated carbon as shown.



5. Secure one magnesium plate on top of the absorbent paper as shown.

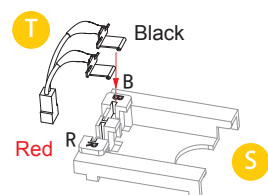


6. Close the battery case cover as shown, make sure it's secured. (Remove some activated carbon if the cover cannot be closed securely.)

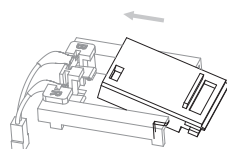


**Disclaimer:** While the activated carbon is safe to handle it is best to be kept away from the eye, mouth, or open cuts. If done so, please use cold water to wash thoroughly the area in which the activated carbon touched.

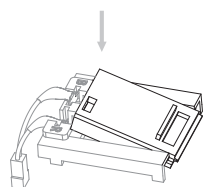
7. Install the wire plates to the chemical reaction box as shown. (Note: insert the Red wire plate to the R side, and the Black wire plate to the B side.)



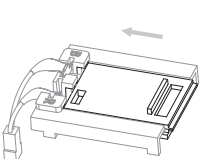
8. Slide the battery case into the chemical reaction box as shown.



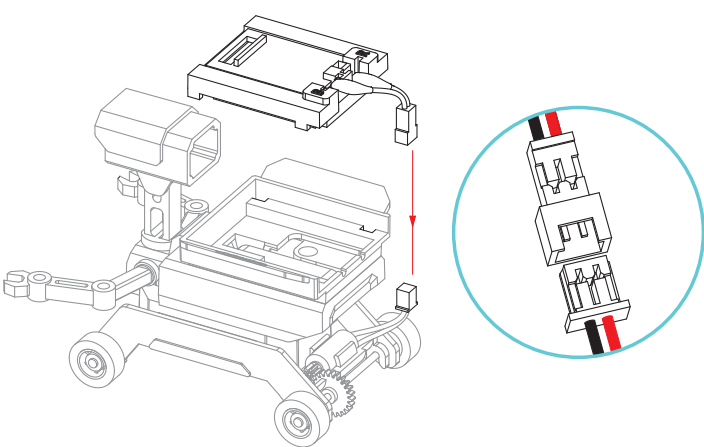
9. Press the battery case down to hold down the two wire plates. Ensure that the copper and magnesium plates are touching the wire plates by placing the battery case above and pushing down until a click can be heard.



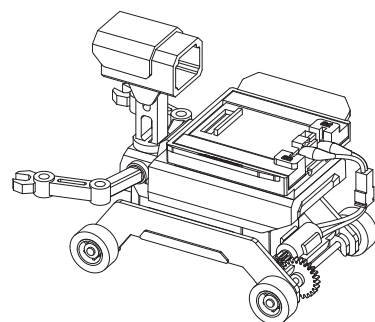
10. Slide the battery case forward to secure in place. (Note: The battery case should not be protruding out the back from the chemical reaction box.)



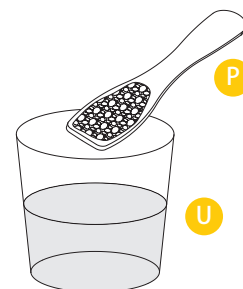
11. Install the finished component on the support case and connect the wires together. (Note: match the right sides of the two connectors, do not plug forcibly. Please ask for parents' help if you have trouble plugging in the connectors.)



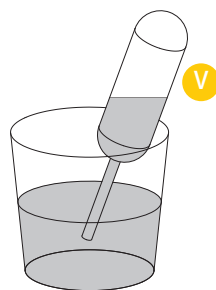
12. The final look after installation.



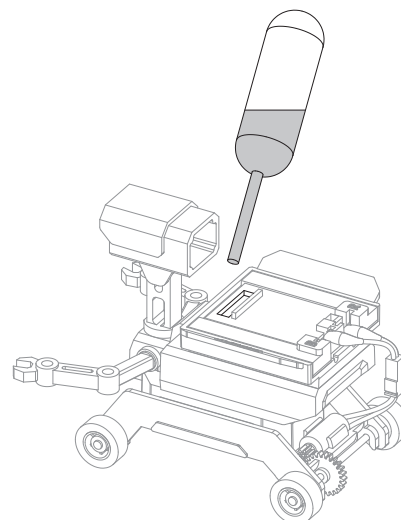
13. Pour 10ml water into the measuring cup and using the given spoon add in 3-4 spoons of any type of salt into the water. Keep stirring the water until the salt is completely dissolved (**saturated**).



14. Use the dropper to collect the salt water.



15. Drop the saturated salt water through the hole on the battery compartment, place the robot car on a smooth and flat surface. The robot car will start running. (Only 10 drops of salt water are needed. Slowly add another drop after the one before has been absorbed completely.)



Wow!  
You did a great job!



### Important! Follow these steps to safely store your robot for future reuse:

1. Unplug the connectors.
2. Remove the chemical reaction box.
3. Pull out the battery case, take out the magnesium plate, copper plate and absorbent paper, dispose the activated carbon.
4. Wash the battery case and wipe it with a paper towel. Keep it for future use.
5. The absorbent paper is reusable. Wash it and try to clean out as much of the activated carbon residue as possible then leave out to dry for future use. Note: The reused absorbent paper should be stored separately from the new ones. You may also use your own paper towels/napkins as absorbent paper for the experiment.
6. Copper and magnesium plates are reusable. Polish them with a sandpaper for future use.
7. After extended usage the magnesium plates will wear out eventually. Please replace if one does not work anymore.

### Troubleshooting

#### Solar Battery

##### Motor doesn't work

- Sunlight is not strong enough, or the solar panel is not facing directly to the sun.
- The solar battery will not work on a cloudy day or indoors. It only works under direct sunlight.
- Solar panel will not work under a flashlight.
- Check the connectors and make sure they are plugged in correctly.

#### Salt Water Battery

##### Motor doesn't work after installing the salt water battery

- Add a few more drops of saturated salt water.
- Lightly push the robot car forward to help it start.
- Make sure the wire plates are in contact with the copper plate and the magnesium plate. Slightly bend the wire plates up to make better contact.
- Check the copper plate and the magnesium plate, make sure they are not in contact.
- Check the connectors and make sure they are plugged in correctly.

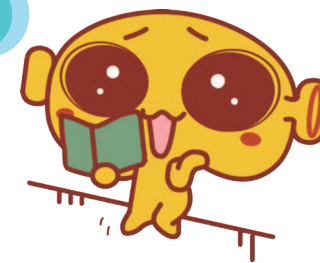
##### The robot car runs backwards

- Switch the wire plates, make sure all the connections and the battery case are put together as illustrated in the instructions.

##### Battery is out of electricity

- Add a few more drops of saturated salt water.
- If the surface of the magnesium plate turned black, polish it with a sandpaper, replace the activated carbon and the absorbent paper.
- Polish the copper plate and the wire plates with a sandpaper.

Let's learn some fun facts!



## Salt Water Battery

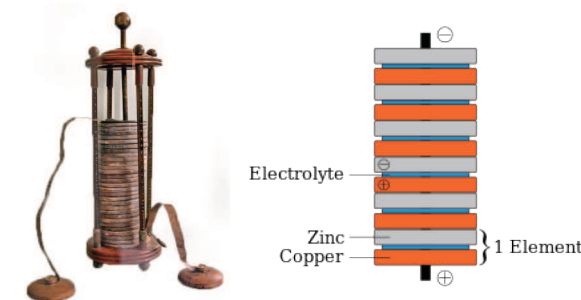
### Alessandro Volta



Alessandro Volta was an Italian physicist & chemist who invented the first battery - Voltaic Pile, in the 1800's. The base word "Volt" in the unit of measurement voltage is named in his honor.

Alessandro Volta (1745-1827) was born to a noble family in the city of Como, Italy. At an early age he was homeschooled by his uncle before going to the Jesuit boarding school where the school pressured him to be a priest. Volta's family had their own plans as they wanted him to be a lawyer. Eventually finding his passion through

electrical science, Volta began to make a name for himself through his research and experiments early in his career. In 1779, due to his scientific achievements, he became a professor of experimental physics at the University of Pavia.



On March 20, 1800, Volta introduced the "voltaic pile", one of the first electrochemical cells, to the Royal Society of London. It is composed of several pairs of alternating copper and zinc discs separated by cardboard soaked in brine. Later on, Volta was able to arrange various metals in a potential series based on multiple experiments. He discovered that when using any two different metals to build a voltaic pile, the preceding metal carries positive charge and the latter metal carries negative charge. This is the "contact potential difference". Due to his scientific achievements, Napoleon Bonaparte rewarded Volta with the title of "Count" and awarded him the "Legion of Honor" the highest French order of merit.

### How is the electricity generated from the salt water battery?

The salt water battery is actually called magnesium air battery, which turns the chemical energy into electricity. It is made of magnesium, copper, activated carbon, absorbent paper, and salt water. All batteries have two electrodes. In this battery, magnesium is one electrode, and oxygen from the air is the other electrode. When magnesium and oxygen in the air have oxidation reaction, electric energy is produced. The absorbent paper is used to absorb salt water into the battery case. The activated carbon is used to absorb oxygen from the air in order to catalyze the reaction. The copper plate is a conductor between the battery case and the wire plate.

The electricity generated here is actually formed by the movement of electrons. The oxygen from air and the water on the absorbent paper, together with electrons, will form a microscopic particle called hydroxide ion. The hydroxide ion will oxidize the surface of the magnesium plate, where electrons are released. The two reactions take place simultaneously, releasing electrons into the salt water. Salt is also known as sodium chloride. When it's dissolved in the water, salt will be broken into chloride ions and sodium ions and serves as the electrolyte so that electrons can flow from magnesium to carbon. Then, through the copper plate and the wires, electrons flow to the motor. This is the process that generates the current to power the motor.

### Solar Battery

Solar battery, also known as "solar cell" or "photovoltaic cell", is a semiconductor with photoelectric effect that utilizes sunlight to generate electricity. Once certain illumination conditions are met, it can output voltage and generate current in a circuit immediately. In physics, it is called Photovoltaic (PV).

Solar battery turns luminous energy into electric energy through photoelectric effect or photochemical effect. Solar energy is a green energy that causes no harm to the environment, but it also has a low conversion efficiency. Even for the best quality monocrystalline silicon solar cell this robot car uses, the conversion efficiency is less than 20%. Thus the robot car only runs under strong sunlight. A cloudy day or indoor environment will not provide enough electricity to power this product. To have the best performance, we recommend play our solar powered robot car under a good sunlight condition.

Modern solar battery was invented by an American Nobel Prize winner Russell Ohl in 1941.

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