ScienceCube

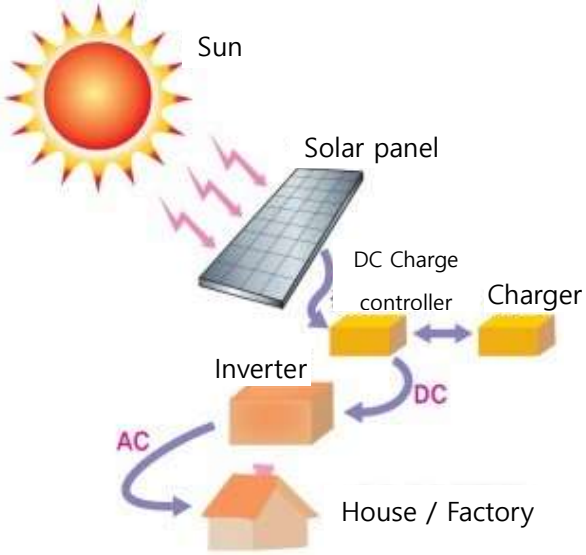
Voltage of Solar Cells

1. **Measure and explain the voltage generated by solar cells depending on the angle and distance of light shining on them.**
2. **Measure and explain the voltage generated by solar cells depending on the connection method.**

Fundamental Concept

1. Solar Power Generation

The sun emits much more energy to Earth than humans need, but we don't fully utilize it. The sun emits about 1021 kcal of heat energy per year, and the amount that Earth receives is about 1/2,000,000,000 of that. The energy the sun sends to the surface of the Earth in one hour is equivalent to the energy consumed by all humanity in one year. Solar power generation is the process of converting some of this energy into electricity.

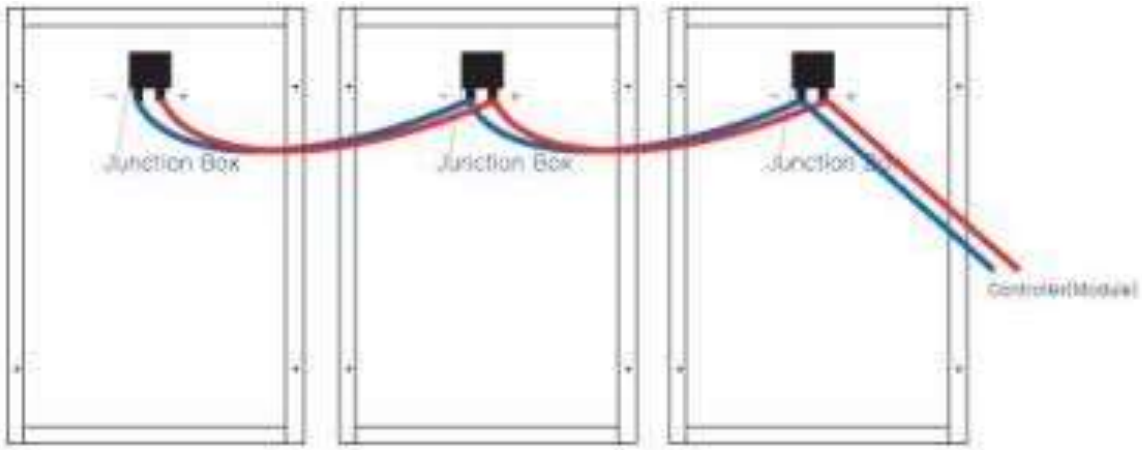


The most common method of using solar energy is to convert it directly into electricity using solar panels made from semiconductors like silicon. This is convenient because it can be installed on rooftops where electricity is needed. However, it has the disadvantage of not generating electricity on cloudy days or at night. Let's experiment to find out how to install solar panels more efficiently to generate electricity.

2. Solar Cell Connections

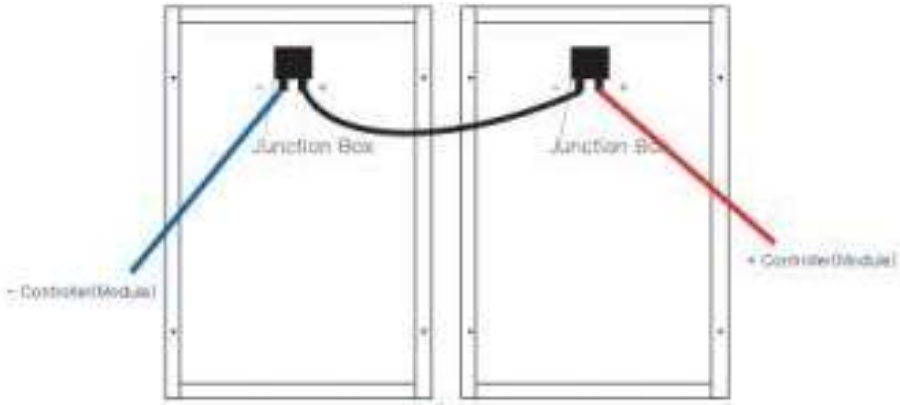
A. Parallel Connection

Connecting solar cells in parallel does not change the output voltage. Instead, the output current increases, allowing for longer usage.



B. Series Connection

Connecting solar cells in series increases the output voltage proportionally to the number of cells.



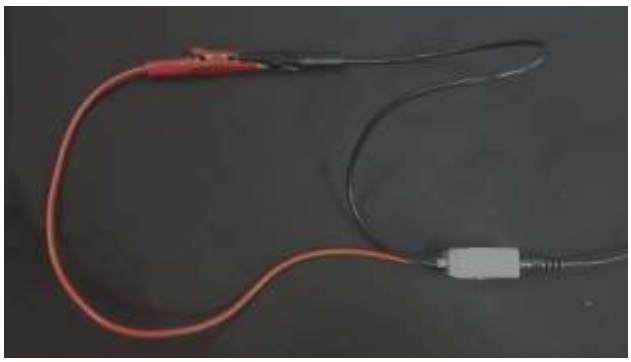
Experiment

Materials Needed

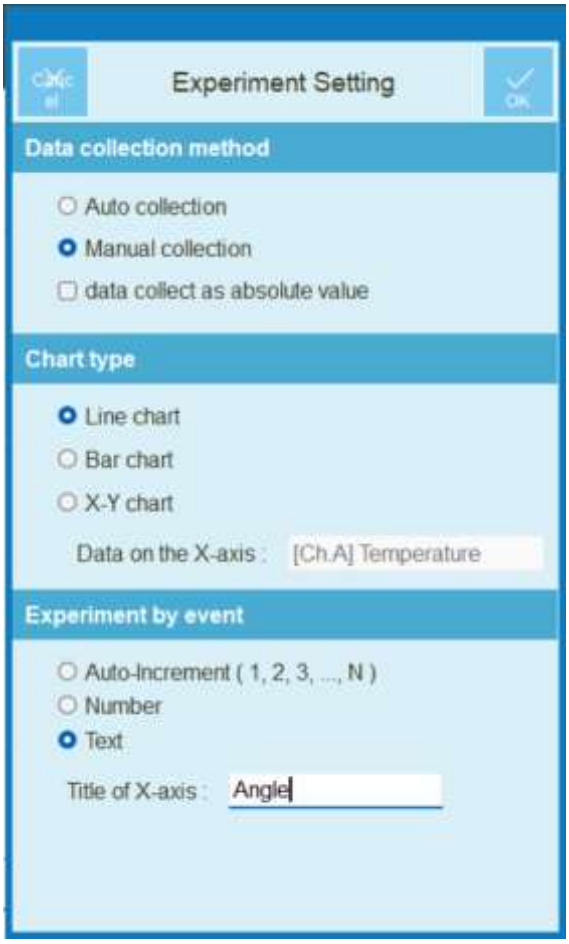
Interface, Science# program (smart device), solar cells (2), voltage sensor, stand light, ruler

Interface Setup

1.  Run Science#.
2. Connect the voltage sensor to the interface.
3. To set the zero point, connect the positive (red) and negative (black) wires of the voltage sensor as shown below.

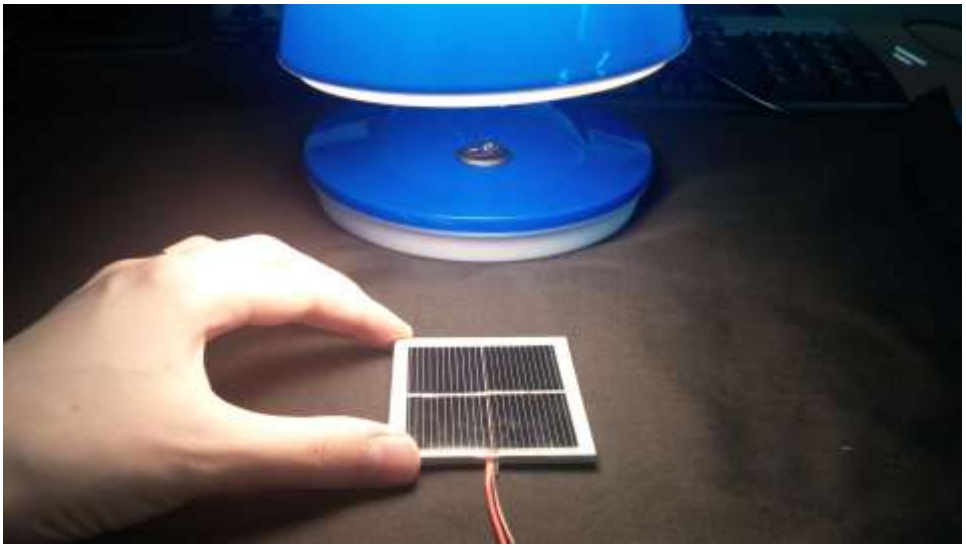


4.  Press to set the zero voltage (0V).
5.  Press to configure the experiment environment or press for automatic setup. 



Data Collection

1.  Press to set to bar graph mode.
2.  Press to start data collection.
3. Connect the red wire and black wire of the solar cell to the red clip and black clip of the voltage sensor, respectively.
4. Turn on the stand light and shine it vertically on the solar cell.



5.  Press and enter "0 degrees" to measure the voltage generated at 0 degrees.
6. Similarly, measure the voltage generated at angles of 30°, 60°, and 90°.

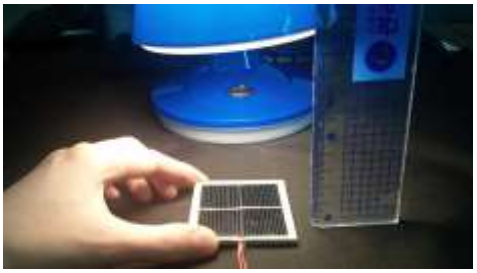
< 0° >

< 30° >

< 60° >

< 90° >

7.  Press to stop data collection.
8.  Press -[New Chart] and measure the voltage generated as you bring the solar cell closer to the light..



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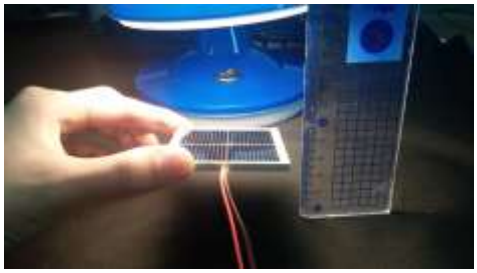

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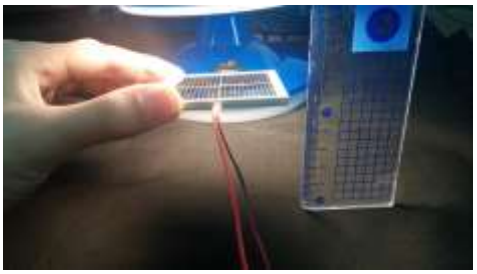

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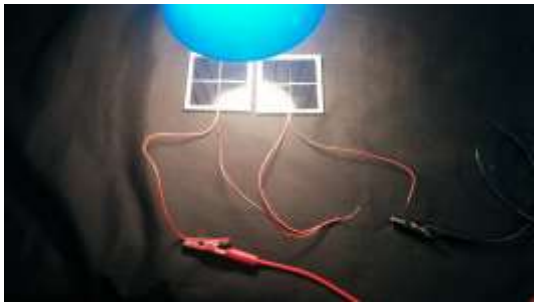
9.  Press to stop data collection.
10.  Press -[New Chart] and measure the voltage generated when two solar cells are connected in parallel and in series..

< Parallel Connection>



< Series Connection>

Data Analysis

Recording Data

1. Draw a bar graph of the voltage generated depending on the angle of light shining on the solar cell.
2. Draw a bar graph of the voltage generated as the solar cell gets closer to the light.

3. Draw a bar graph comparing the voltage generated when two solar cells are connected in parallel and in series.

Data Application

1. Explain the relationship between the angle of light shining on the solar cell and the generated voltage. Based on this, describe how to install solar panels to obtain efficient voltage.

2. Explain the relationship between the distance of the light from the solar cell and the generated voltage. Based on this, describe where to install solar panels to obtain efficient voltage.

3. Explain whether to choose parallel or series connection when connecting two or more solar cells, and provide reasons for your choice.