

**CCC MONG MAN WAI COLLEGE**  
**S2 SCIENCE STEM ACTIVITY**  
**Making of Titanium dioxide Solar Cell and its Performance**

Name : \_\_\_\_\_ ( ) Class : S2 \_\_\_ Date : \_\_\_\_\_ Score : \_\_\_\_\_/30

**Learning goals**

Science	Technology	Mathematics
<ul style="list-style-type: none"> <li>➤ Understand the structure of a simple cell</li> <li>➤ Understand the use of a solar panel</li> </ul>	<ul style="list-style-type: none"> <li>➤ Learn to apply scientific knowledge in making a titanium dioxide (TiO<sub>2</sub>) solar cell</li> </ul>	<ul style="list-style-type: none"> <li>➤ Acquire the skills in data collection and processing for the investigation of light intensity and electric current of the solar cell</li> </ul>

**Pre-lesson tasks (9 marks)**

✧ Watch a video of lemon cell to identify the components of a simple cell.

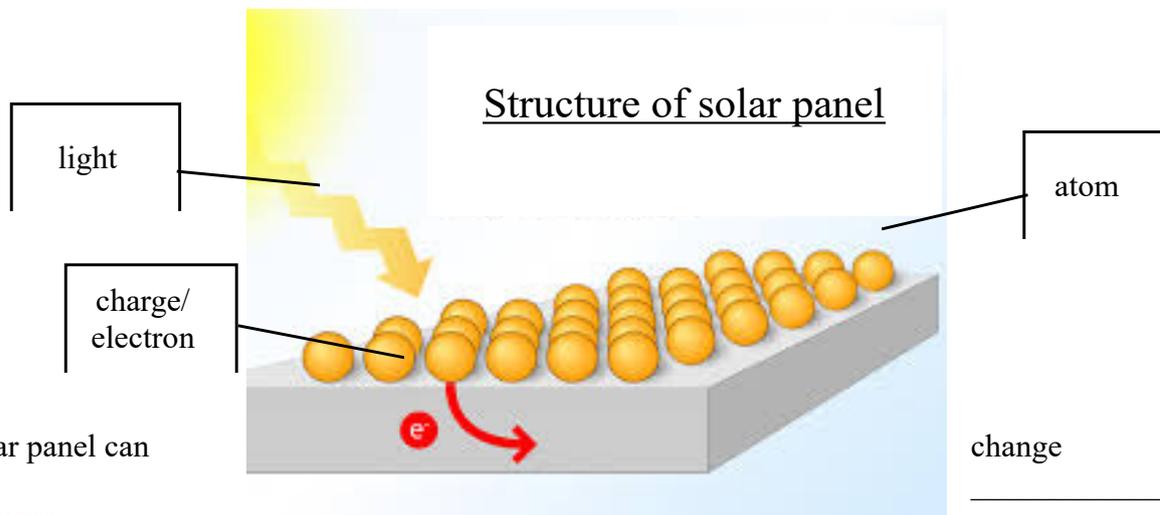
A simple cell is made of

two different substances \_\_\_\_\_ (different strengths of attractions on charge/electrons)

and a conducting liquid \_\_\_\_\_ (electrolyte, for better contact and conductivity).

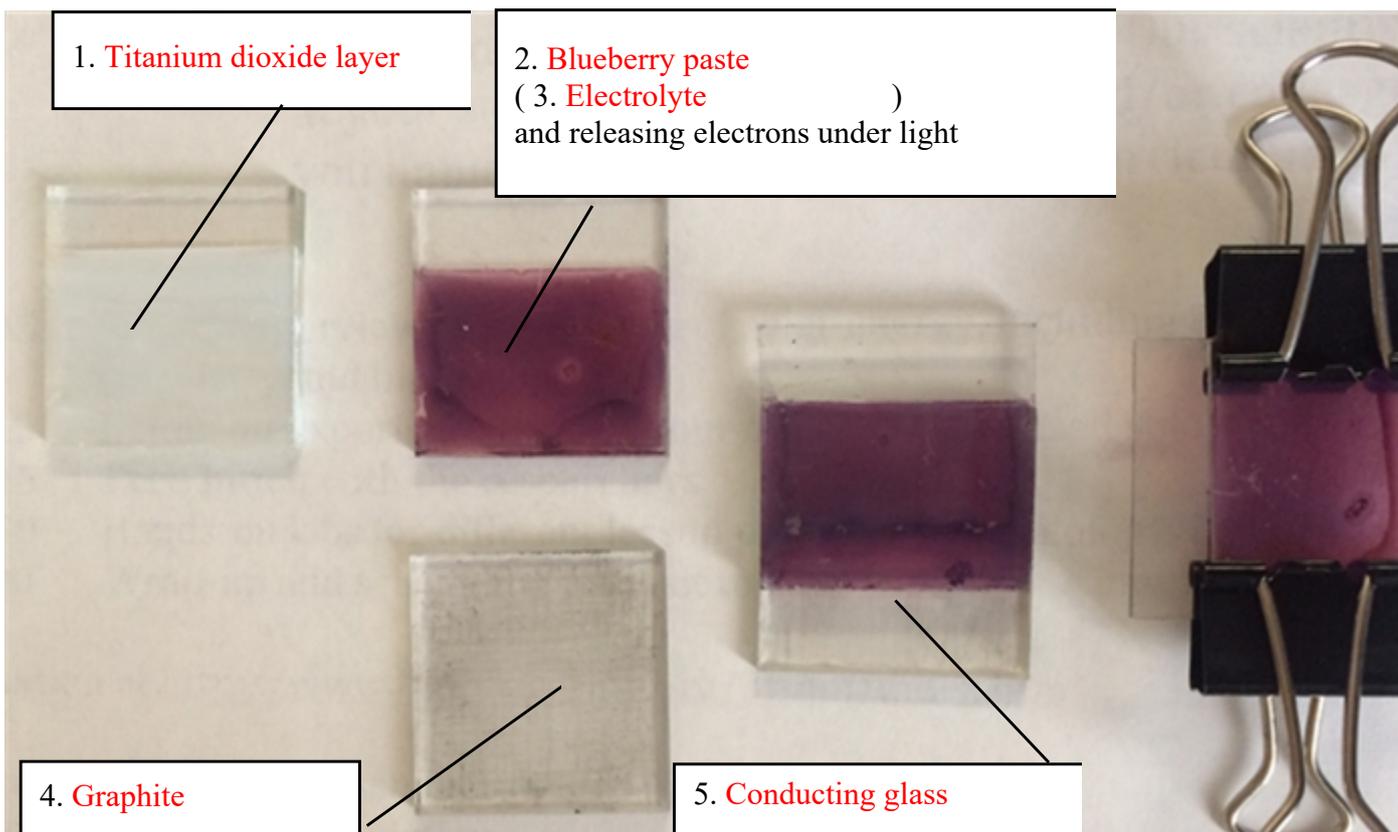


✧ Study the following diagram to recognize the use of a solar panel.



✧ Label the solar cell in the below diagram with the given words.

Titanium dioxide layer Graphite Blueberry paste Electrolyte Conducting glass

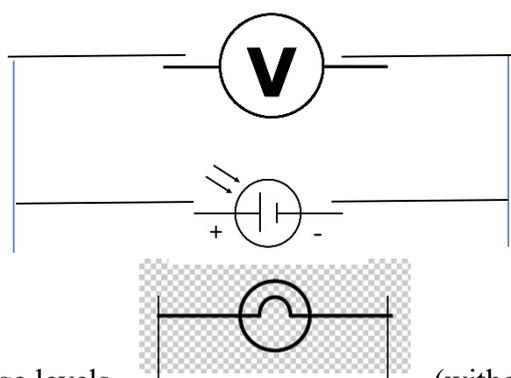


**Lesson Task**

**Design and making the dye-sanitized solar cell**

Procedures:

1. Shade one surface of the slide without titanium dioxide layer using graphite.
2. Combine the two slides with clips as shown in the above diagram.
3. Add blueberry/redberry as an electrolyte to the space between the two slides.
4. Set up the electric circuit as shown in the following diagram.



5. Measure the background voltage levels with blueberry paste in darkness. (2 marks)

Results (Using blueberry/redberry):

Background voltage levels

Set-up	Experimental Set-up (With table lamp)	Control Set-up (Without table lamp)
Voltage (V)		

Depend on teacher's answers

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Investigation: To find the relationship between light source distance and voltage of solar cell

Distance away from the set-up (cm)	Experimental Set-up (With table lamp) Voltage (V)
70	
60	
50	Depend on students' answers
40	

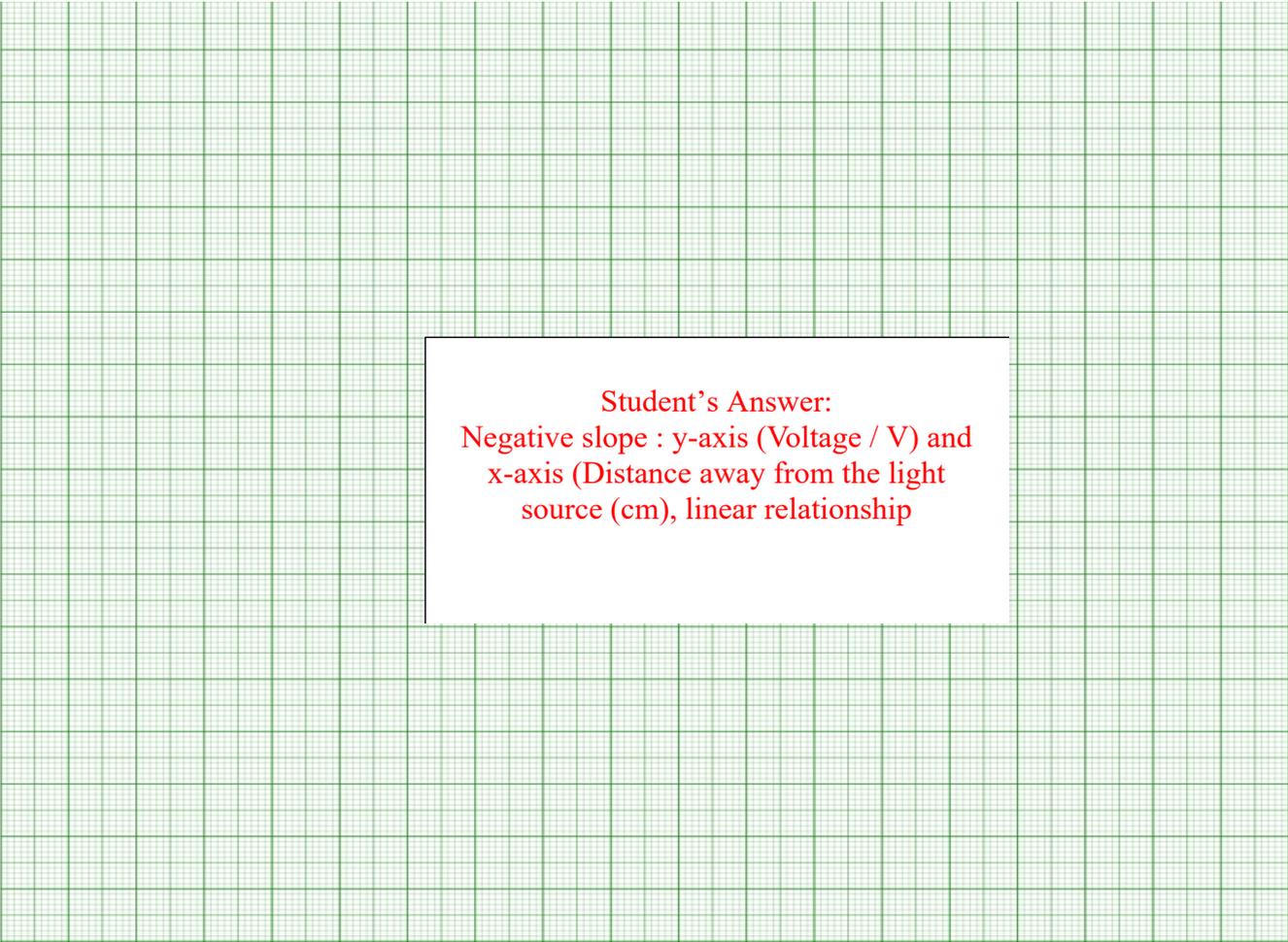
**Discussion**

- Where does the power come from when we are using a solar cell? (Hint: What causes the electrons in the dye to move?) (1 mark)  
Light
- A leaf and a solar cell both convert solar energy into another type of energy. What type does a solar cell make, and what type does a leaf make? (4 marks)  
 A solar cell: light energy → chemical energy  
 A leaf: light energy → chemical energy

3. From investigation, what is the relationship between the distance away from the light source and the voltage produced by the solar cell? Plot the graph of the distance away from the light source against the voltage. (5 marks)

The shorter the distance away from the light source, the higher the voltage produced by the solar cell.

Title: The effect of distance away from the light source to the voltage produced by the solar cell



Student's Answer:  
Negative slope : y-axis (Voltage / V) and  
x-axis (Distance away from the light  
source (cm), linear relationship

4. What are independent, dependable and controlled variables in the investigation? (4 marks)

Independent variable: The distance away from the light source (light intensity)

Dependent variable: The voltage produced by the solar cell

Controlled variables (write TWO): Temperature, Same size of FTO glass

5. Compared with a convectional electric cells (batteries), solar cells use renewable energy instead.

What is renewable energy? Why is it important to develop compared with non-renewable energy (e.g. fossil fuels)? (2 marks)

Renewable energy is energy from natural sources that are replenished at a higher rate than they are consumed. Using renewable energy can produce no greenhouse gas which can reduce global warming. Producing renewable energy can produce no air pollutants which can reduce air pollution. Using renewable energy can diversify energy supply and reduce dependence on imported fuels. (Or other reasonable answers)

6. Can you suggest how solar cells are able to be used in different aspects to tackle the challenges from global warming? (3 marks)

Myself:

Using solar cells can reduce the use of electricity at home which can reduce production of greenhouse gases. (Or other reasonable answers)

School:

Using solar cells can operate some electrical appliance which can decrease the dependence on fossil fuels in electricity generation. It can reduce electricity bills. (Or other reasonable answers)

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Society / Government:

Some non-governmental organizations can make use of solar cells to replace the use of fossil fuels in electricity production. It can reduce emission of greenhouse gases. Government can encourage government departments and buildings to make use of solar cells which can reduce dependence of imported foreign oil and fossil fuels. It can also diversify energy supply. (Or other reasonable answers)

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### **Self-reflection**

After you completed the activity and worksheet, can you reach the learning goals? (Put a tick ✓ in the boxes below)

- Understand more about the design and structure of a dye-sensitized Titanium dioxide solar cell (DSSC)  
 Agree       Partly agree       Disagree
- Understand how to use DSSC to generate current.  
 Agree       Partly agree       Disagree
- Know how to carry out scientific investigation of the solar cell.  
 Agree       Partly agree       Disagree
- Can successfully collect the experimental data and analyze the results  
 Agree       Partly agree       Disagree