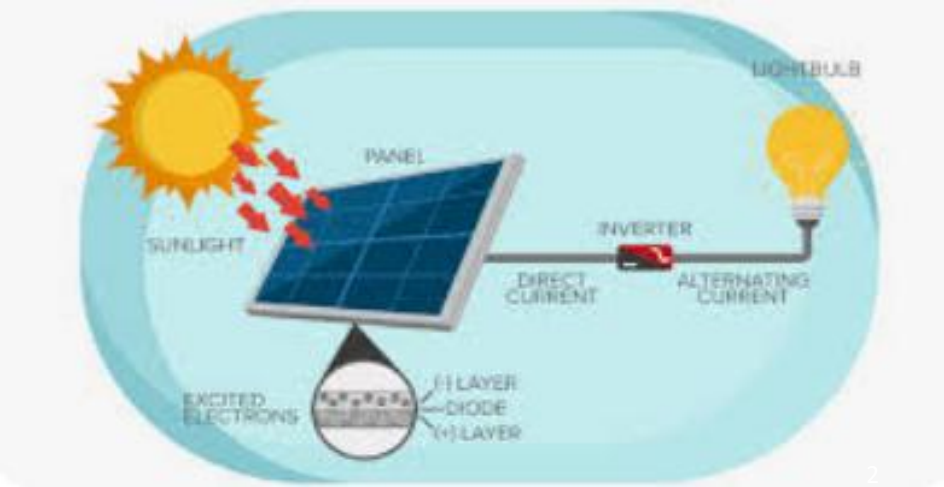
C.C.C. Mong Man Wai College

DESIGN AND MAKING OF DYE-SENSITIZED TITANIUM DIOXIDE SOLAR CELL

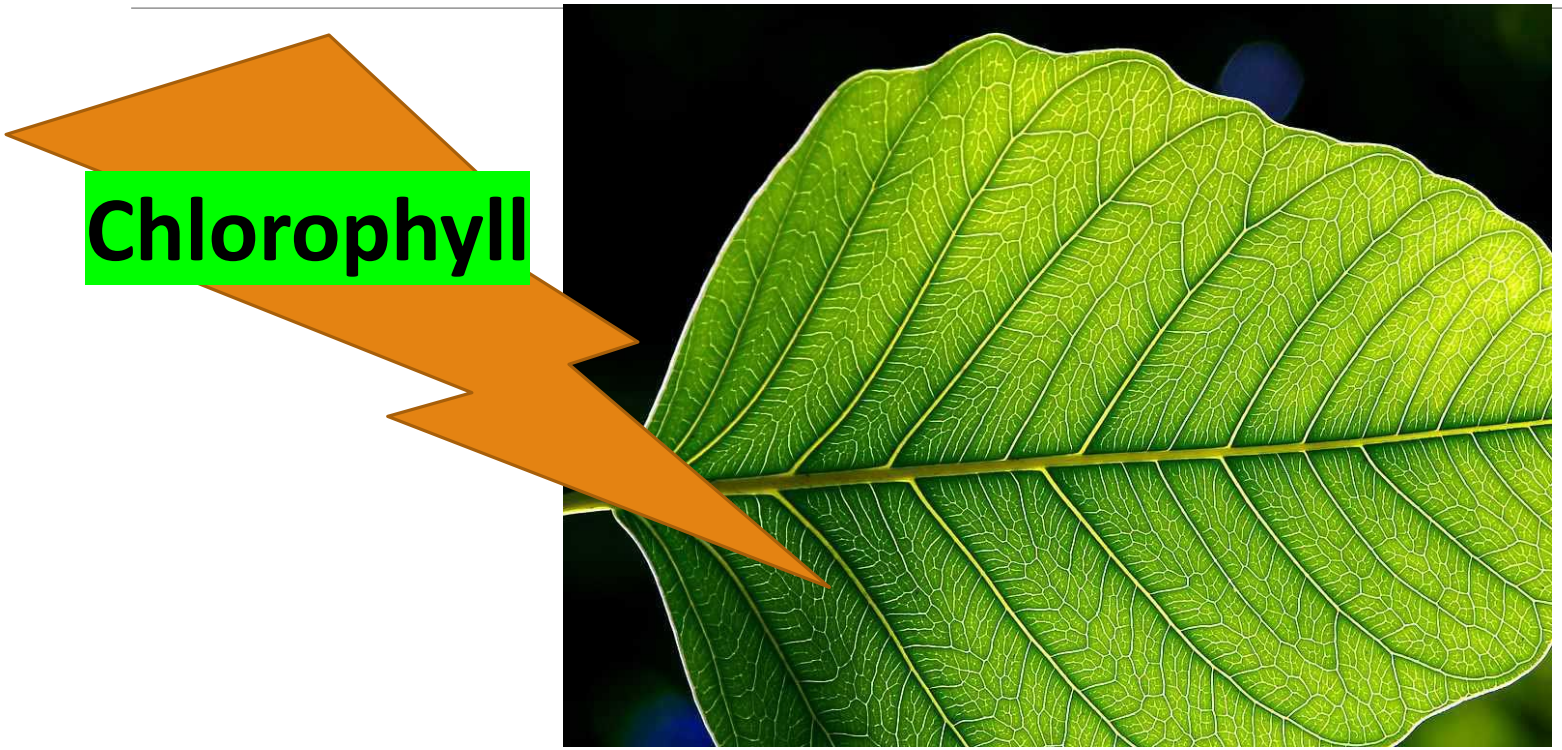
Scenario

Solar energy is a kind of renewable energy which can supply continuously. Recently, renewable energy (green energy) is very popular and many developed countries are developing this valuable energy resources.

Some students suggested if they can make use of solar energy to produce electricity which can be used to power electrical devices or appliance in school or at home.



What is a solar cell?



A solar cell is a device that collects solar energy and converts it into electricity

We can break down what solar cells do into three steps:

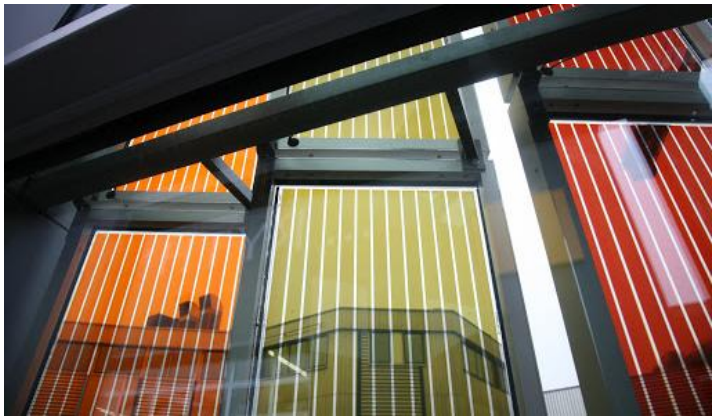
1. **Absorption** of light

2. **Conversion** of light into moving electrons (we call this ELECTRICITY!)

3. **Collection** of ELECTRICITY to power our world

What do solar cells look like?

These are solar panels at Caltech!



silicon solar cells vs. organic solar cells

How does an organic solar cell work?

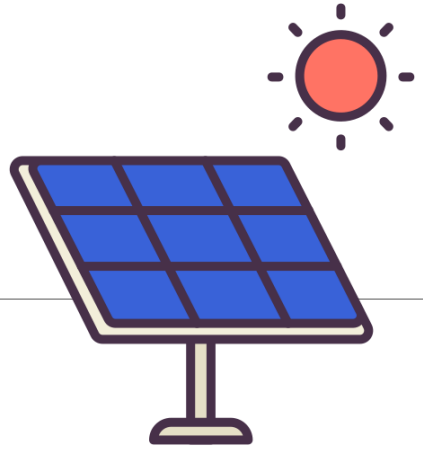
Anthocyanin **(Blue Berry Dye)**

- Able to absorb light as chlorophyll
- A good light absorber: can absorb strong light

Learning Objectives

1. You can describe the basic structure of a cell.
2. You can state the key use of a polar panel.
3. You can show the relationship between light intensity and solar cell volage.

Pre-lesson Task



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

  SCAN ME

  A simple cell is made of

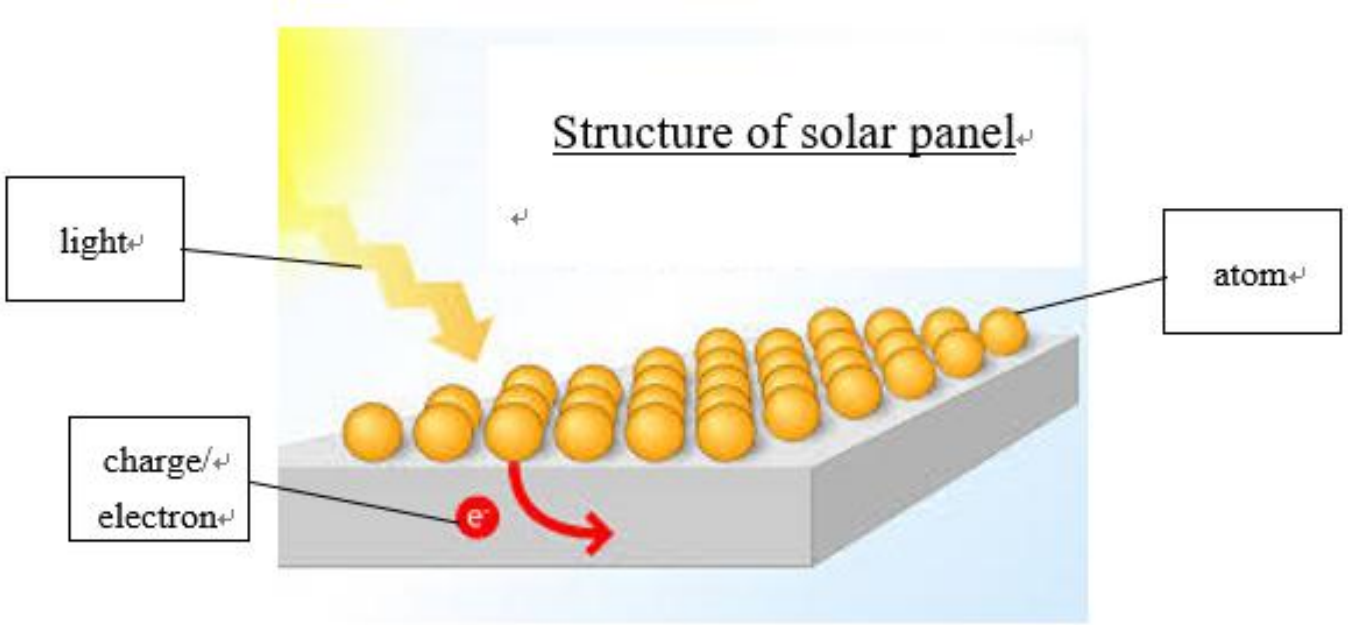
  two _____ (different strengths of attractions on charge/electrons)

  and a _____ (electrolyte, for better contact and conductivity).

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

Pre-lesson Task

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

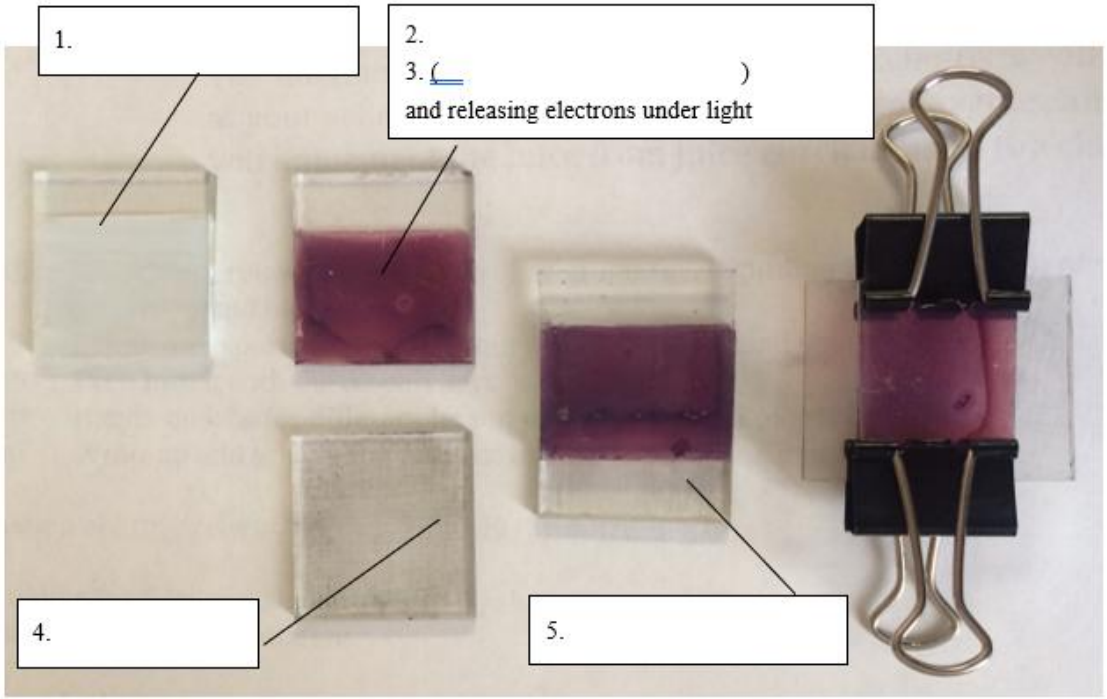


A solar panel can absorb _____ to release _____.

Pre-lesson Task

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

Titanium dioxide layer	Graphite	Blueberry paste	Electrolyte	Conducting glass

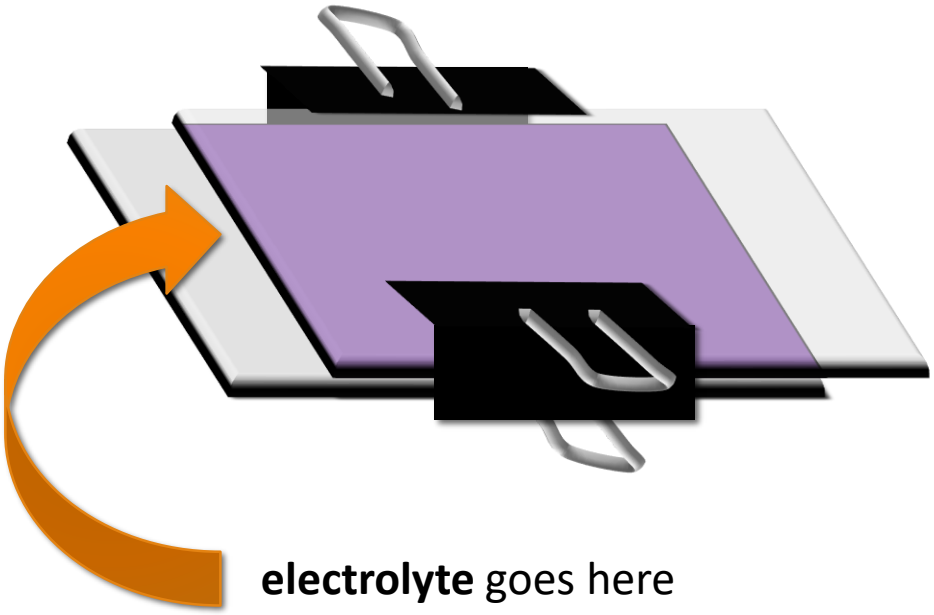


Pre-Lesson Task

Reminder 1: Shade the slide without titanium dioxide using graphite.

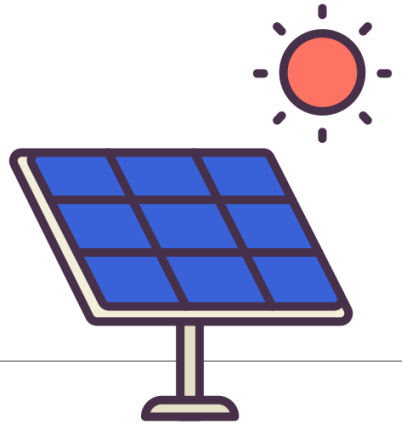
Pre-Lesson Task

Structure of the solar cell



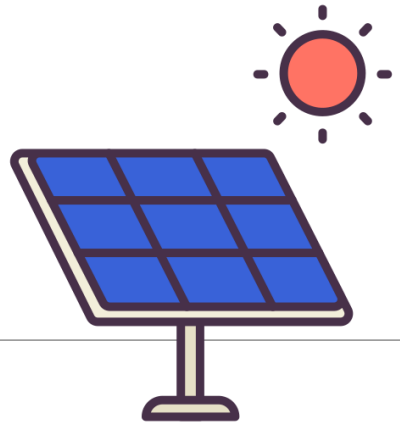
We add **electrolyte** (**conducting liquid**)
to the gap between the two slides

Self-assessment by group



Is your solar cell satisfactory?
Why?

Lesson Task



Procedures:

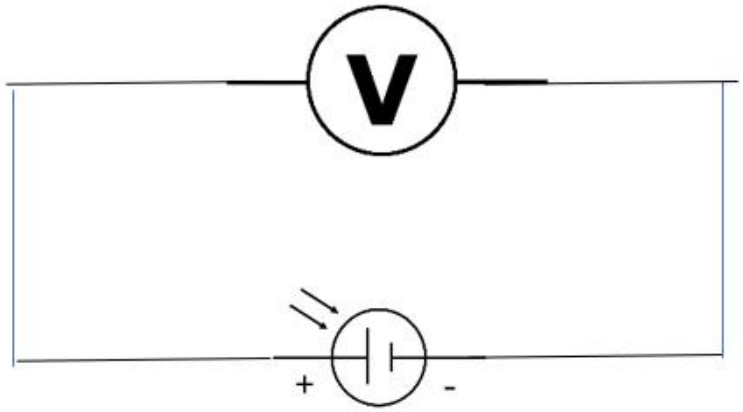
1.Shade one surface of the slide without titanium dioxide layer using graphite.

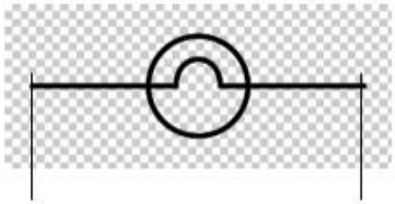
2.Combine the two slides with clips as shown in the above diagram.

3.Add blueberry/redberry as an electrolyte to the space between the two slides.

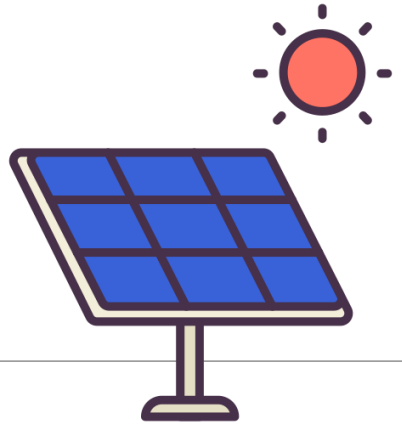
Lesson Task

4. Set up the electric circuit as shown in the following diagram.





Lesson Task



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	
40	

Peer assessment by group

Which group has the best data?

Why?

Discussion

1. 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)

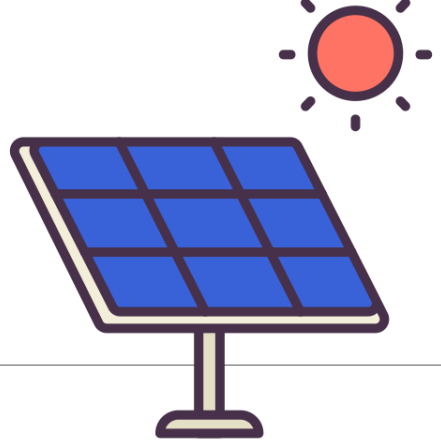
   _____

2. 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: _____ → _____

   A leaf : _____ → _____

Lesson Task



5. Measure the background voltage levels (without blueberry paste in darkness and with blueberry paste in darkness. (2 marks)

Results (Blueberry/redberry):

Background voltage levels

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

Discussion

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

Title: _____

Discussion

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

   Independent variable: _____

   Dependent variable: _____

   Controlled variables (write TWO): _____

   _____

Discussion

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)

Discussion

6.

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