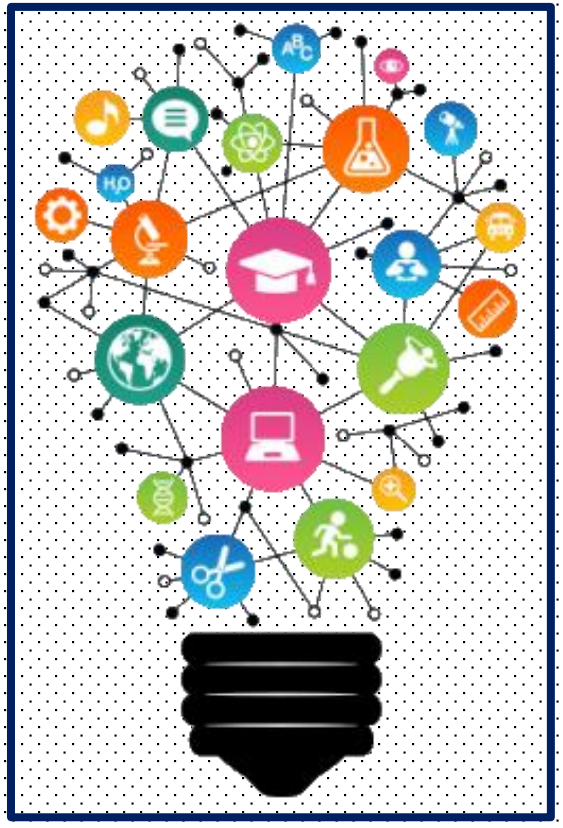
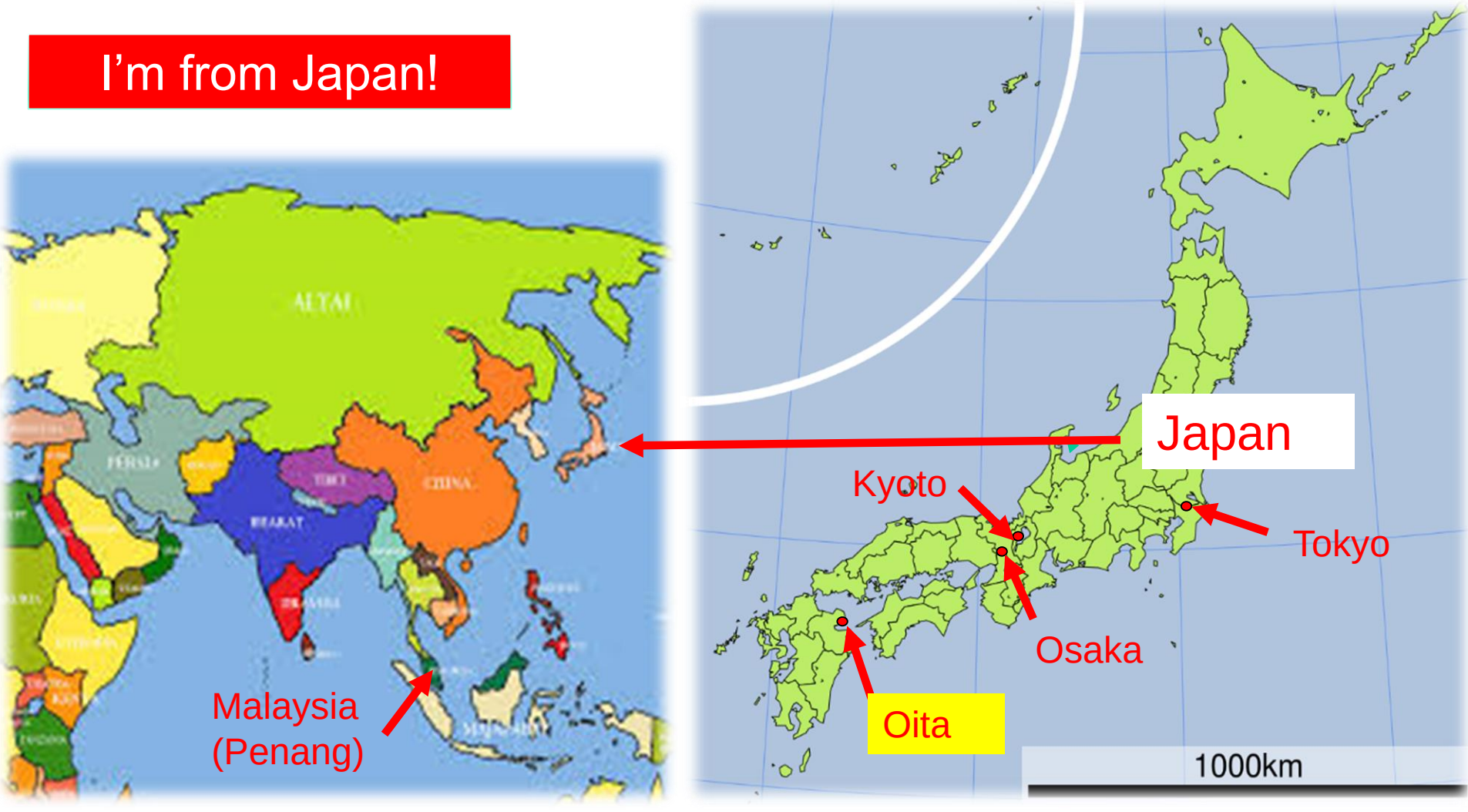
WORKSHOP on Effective Inquiry-Based Learning in Science Lesson



Facilitator: Yuji OTSUKA
SEAMEO RECSAM Specialist
(15-16. Aug.2019)

I’m from Japan!




オノデン


KONICA MINOLTA

What is Inquiry-Based Learning ?

In inquiry-based learning,

learning is driven by students.

Teachers provide a framework about the topic,

and students take the lead asking questions they are interested in.

The teacher then guides them in creating an investigation to answer those questions.

After students have collected data, they make conclusions.

Teachers can then introduce the scientific concepts that apply to what the students have discovered, or continue the inquiry cycle.

The result is a high interest lesson that sticks with the students for years to come.

Types of Student Inquiry

By: @trev_mackenzie

Structured Inquiry

Students follow the lead of the teacher as the entire class engages in one inquiry together.

Controlled Inquiry

Teacher chooses topics and identifies the resources students will use to answer questions.

Guided Inquiry

Teacher chooses topics/questions and students design product or solution.

Free Inquiry

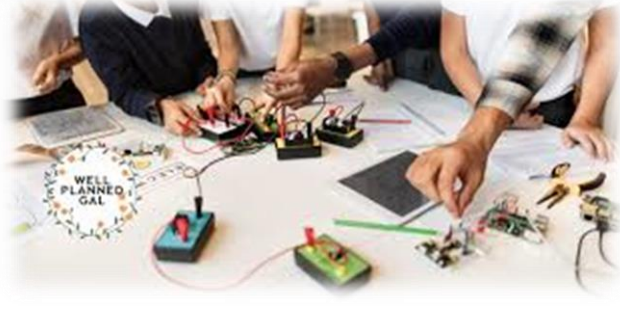
Students choose their topics without reference to any prescribed outcome.

The Scientific Process

1. Ask a **Question**
2. Set a **Purpose**
3. Plan & **Research**
4. Make a **Hypothesis**
5. **Experiment** & Gather Data
6. **Analyze** the Data
7. Draw a **Conclusion**
8. **Reflect** on the process & results

PROCESS SKILLS

- ✓ observing
- ✓ measuring
- ✓ classifying
- ✓ inferring
- ✓ predicting
- ✓ communicating

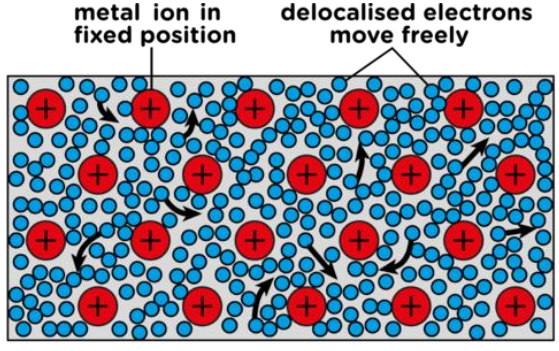


Pre Inquiry-Based Learning

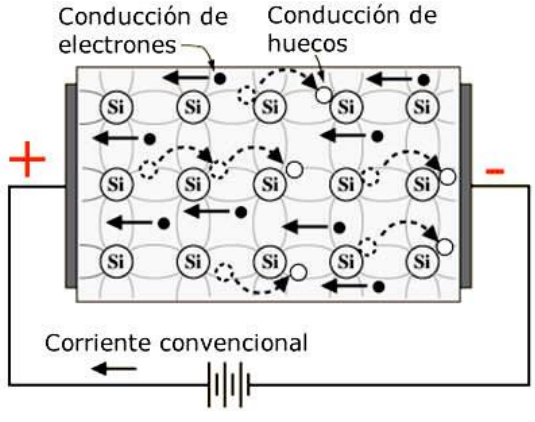
Q1. In which materials can electricity flow ?

Materials

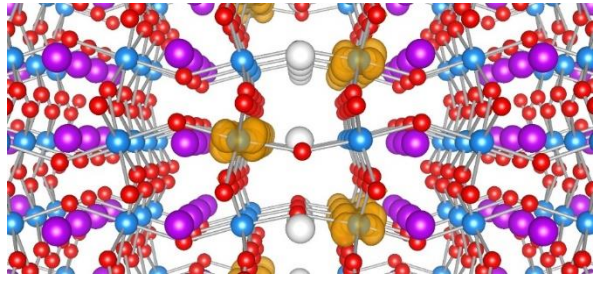
- Conductor



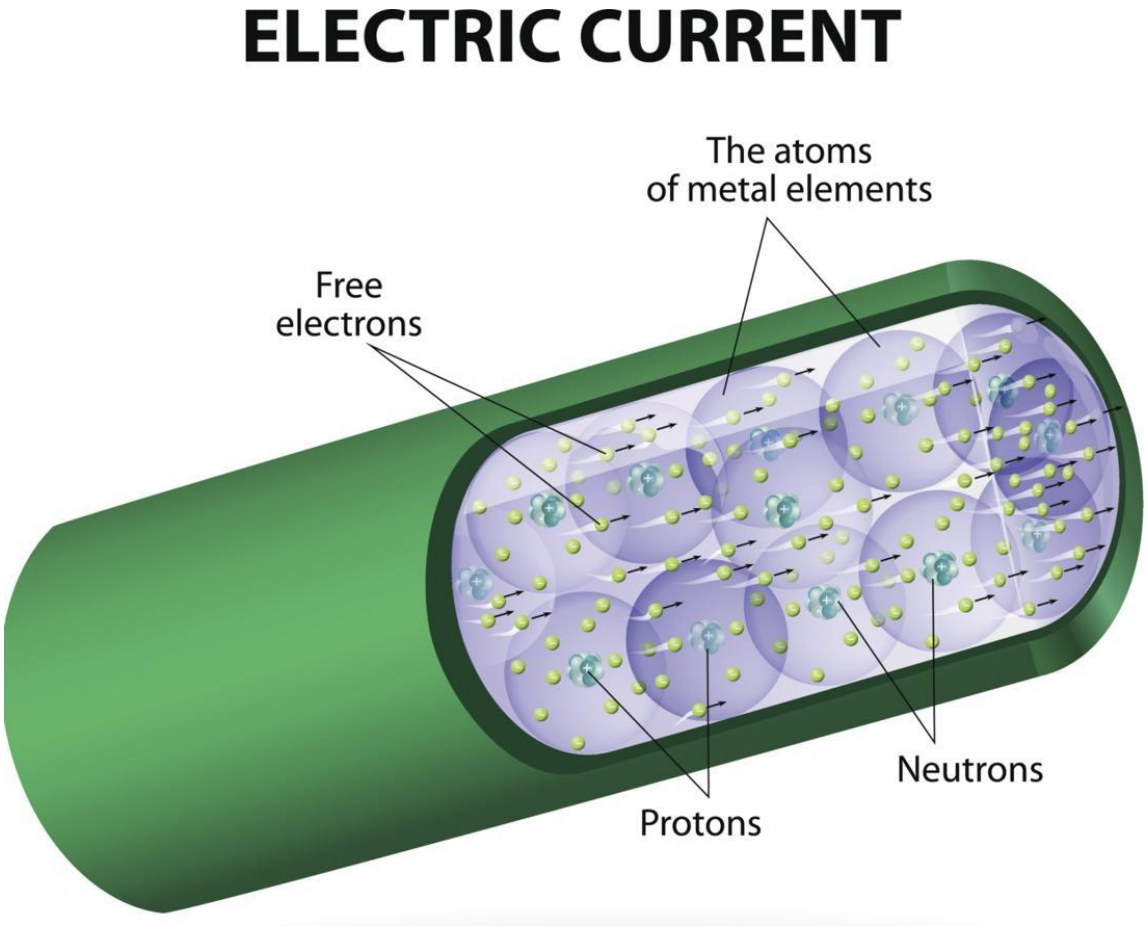
- Semi-Conductor

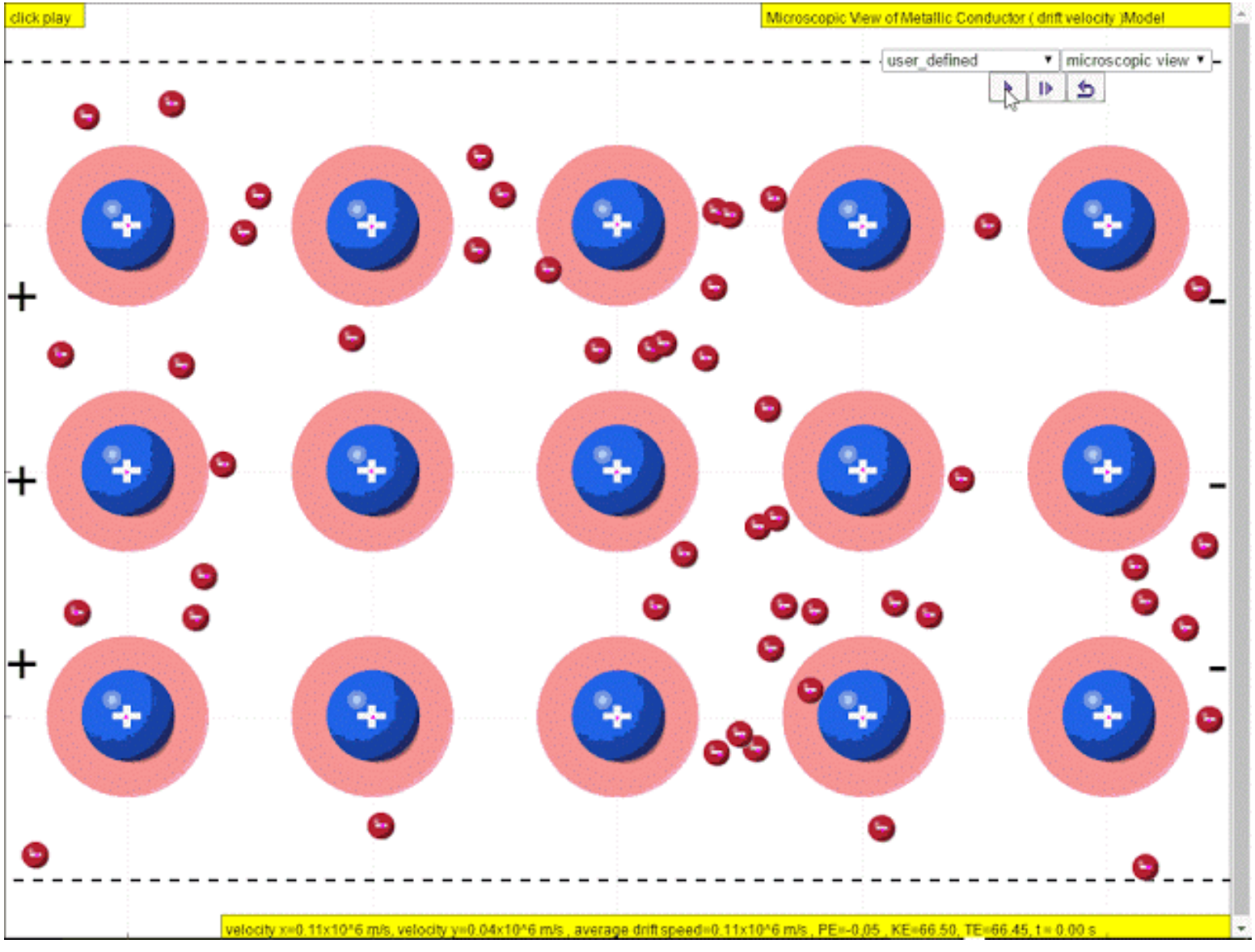


- Insulator

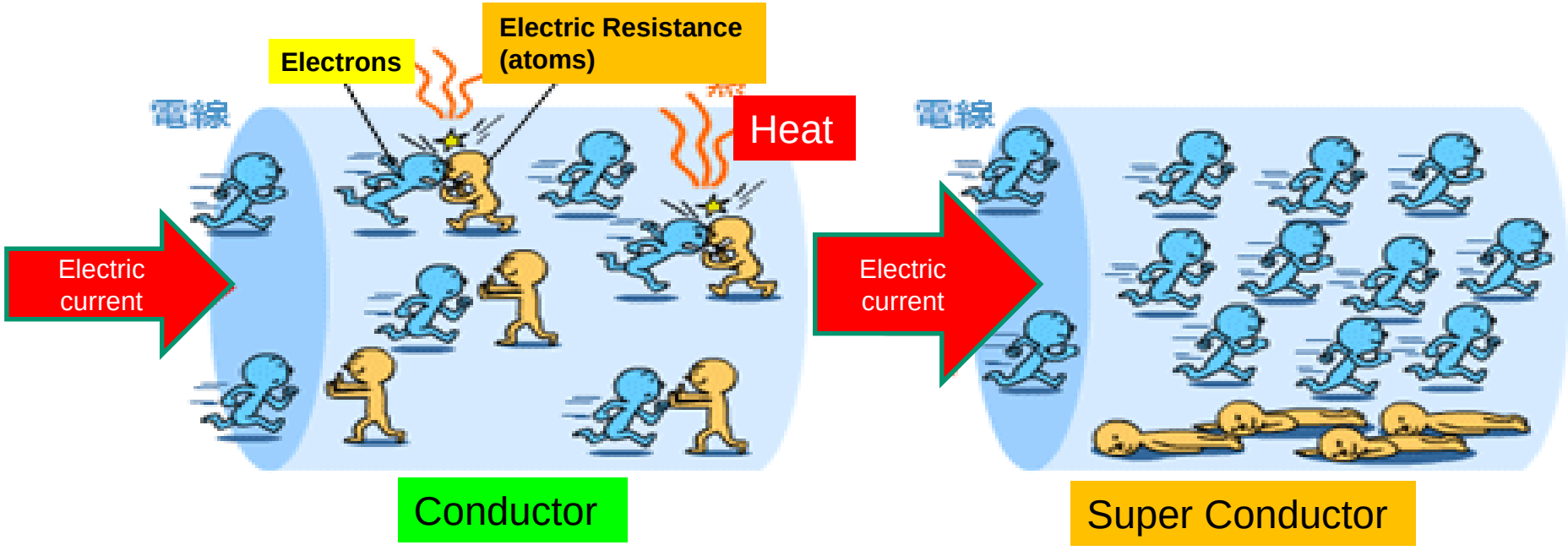


Q2. What is meaning of “Voltage”, “Electric current” or “Resistance”?



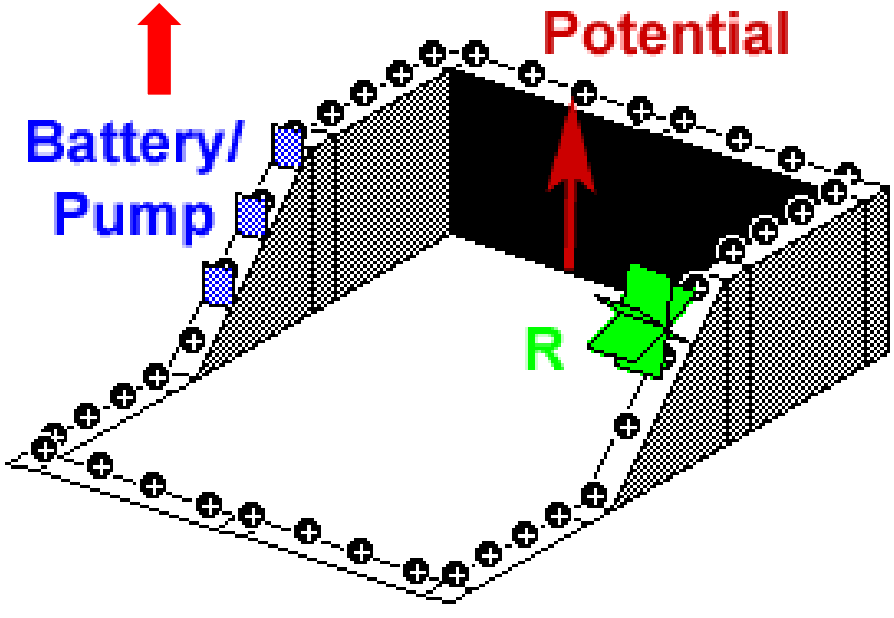

click play
Microscopic View of Metallic Conductor (drift velocity)Model
user_defined
microscopic view
velocity x=0.11x10^6 m/s, velocity y=0.04x10^6 m/s , average drift speed=0.11x10^6 m/s , PE=-0.05 , KE=66.50, TE=66.45, t = 0.00 s

Electric Resistance caused by atoms

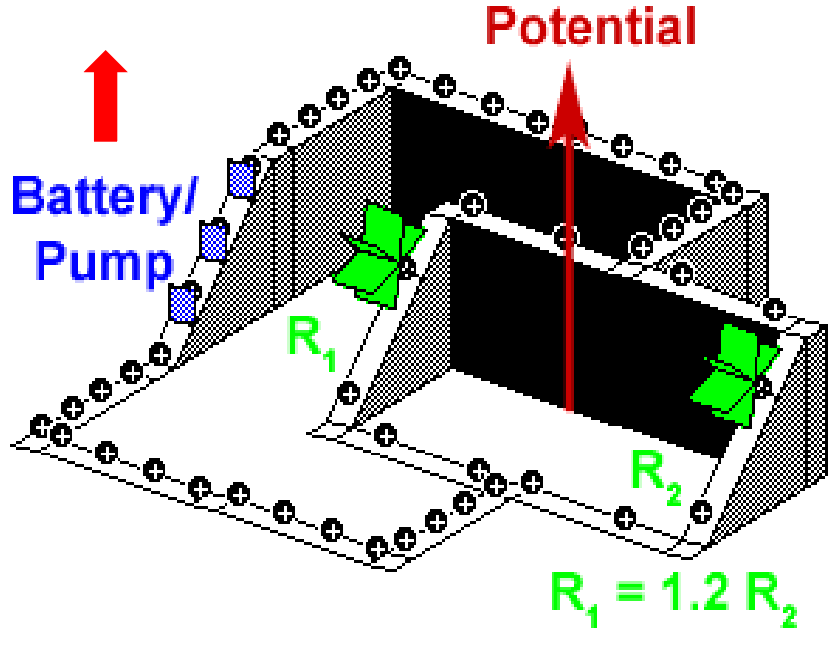


Voltage

Electrical pressure (Voltage)



Electrical pressure (Voltage)

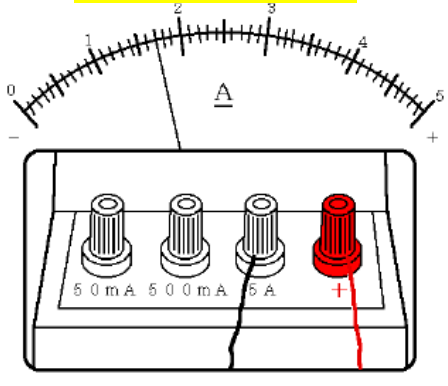


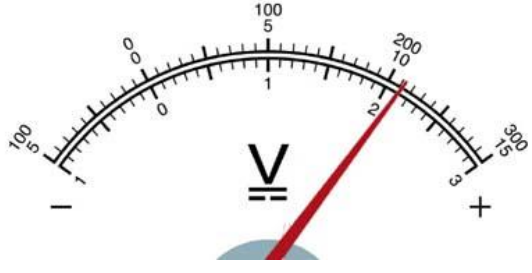
How to measure the electric current and voltage

Let's read the scale of meters!

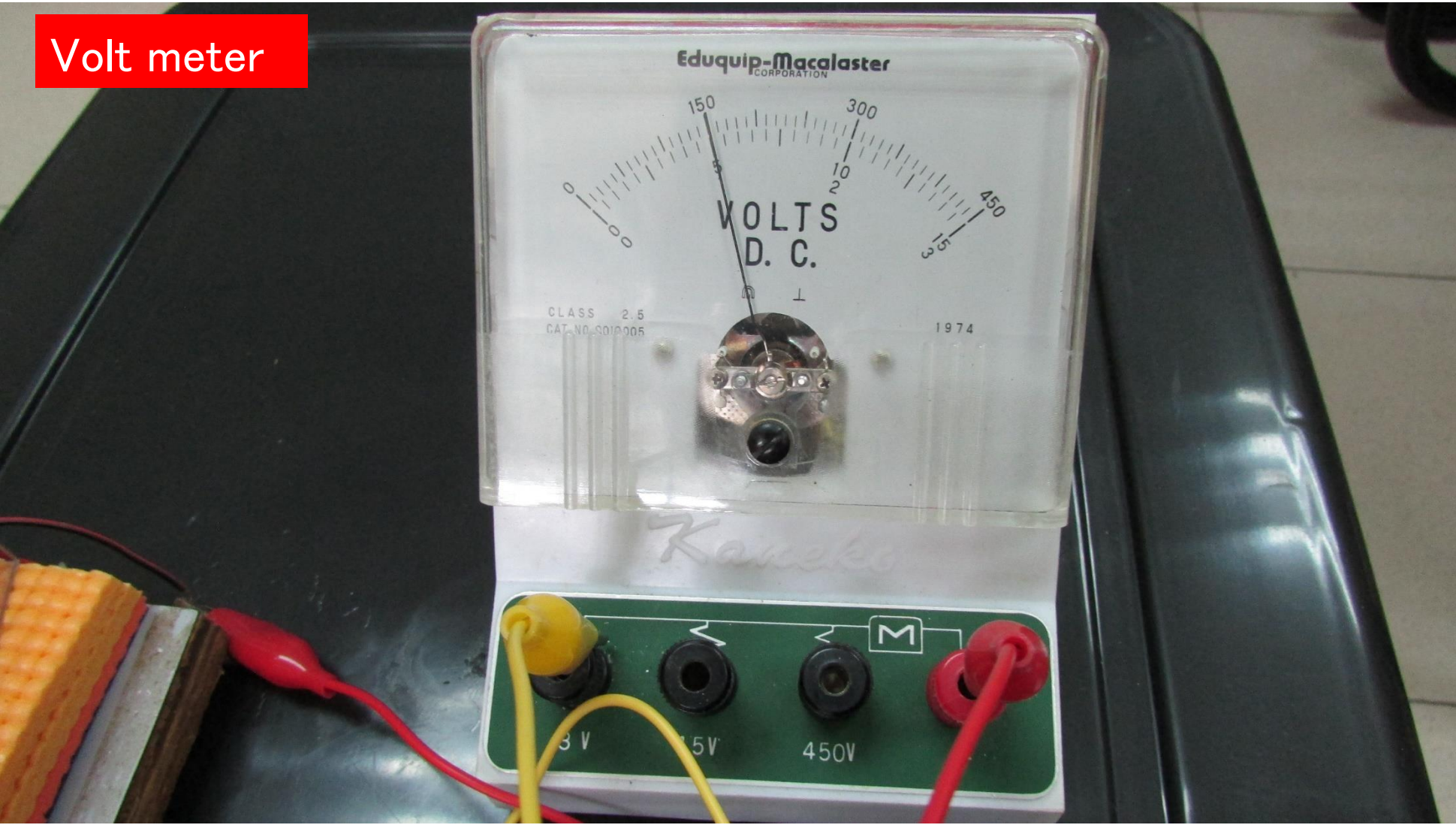
Ammeter

Voltmeter



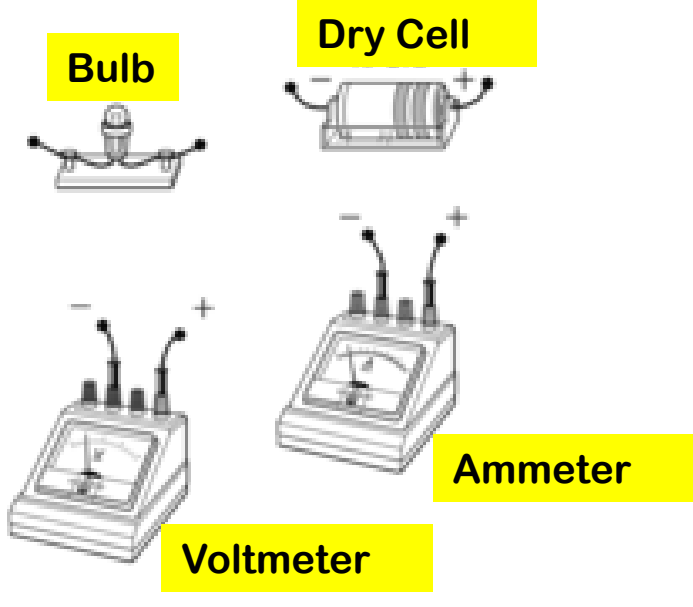


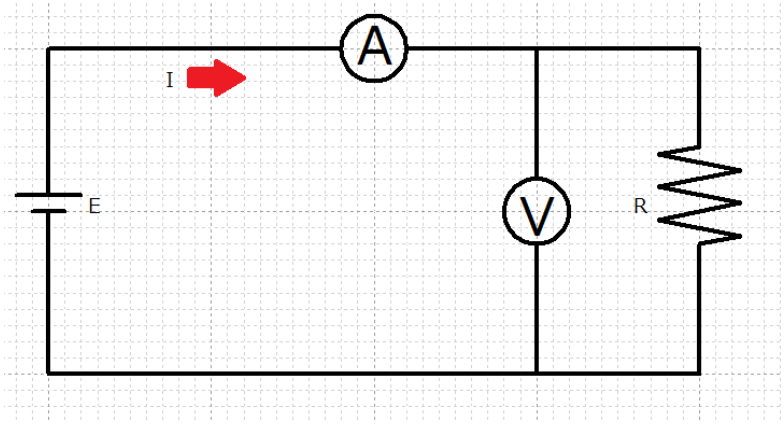
Experiment & Gather data



Tester

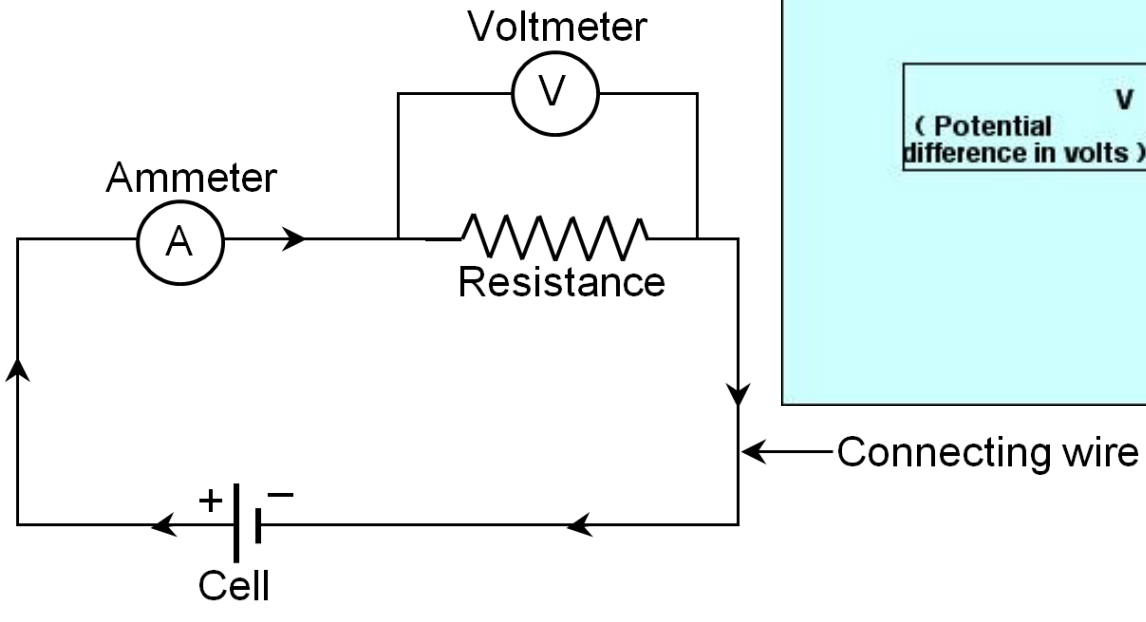
Activity 1 Try to connect the meters with the electrical circuit !

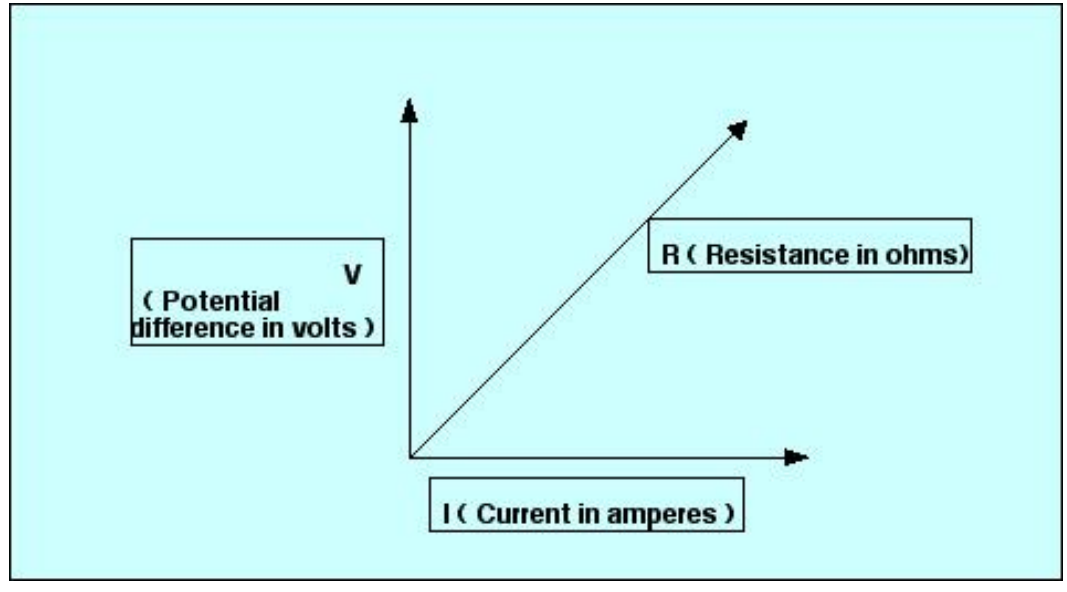




Q3. What are there any relationship among “Voltage”, “Electric current” and “Resistant”?

Activity 2





Formula

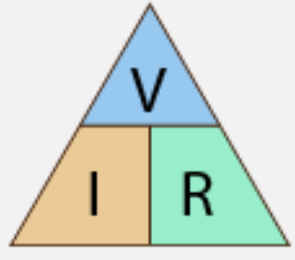
Ohm 's law :

$$V = IR \qquad I = \frac{V}{R} \qquad R = \frac{V}{I}$$

V ⟶ Voltage (V)

I ⟶ Current (A)

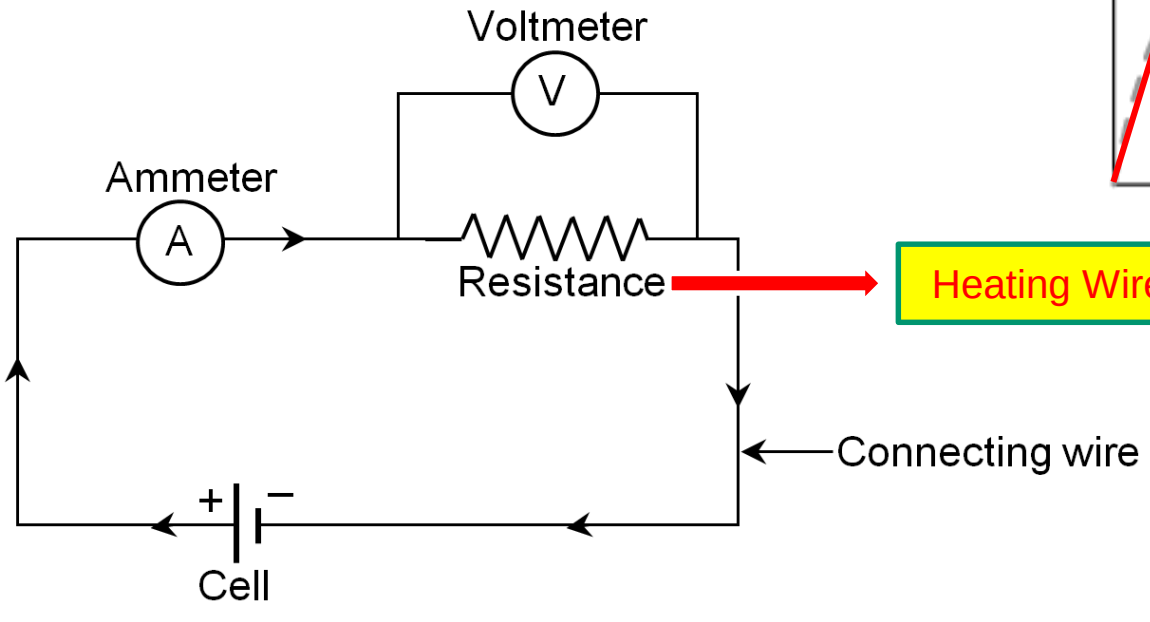
R ⟶ Resistance (Ω)

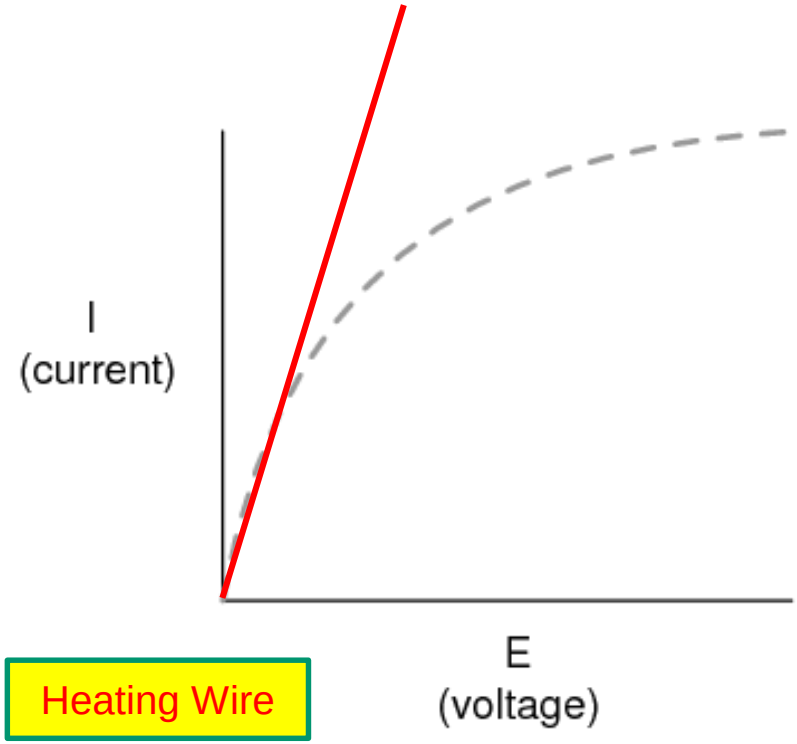


Activity 3

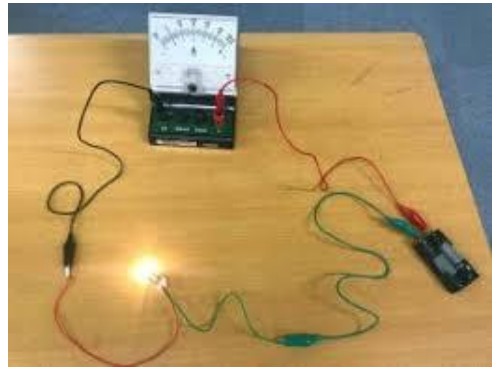
Q : Why electric current is not proportion to voltage?

$I = (1/R)\,V$ (Ohm's law)





Pre Inquiry-Based Learning



Asking Question

Why is every electrical appliances connected in parallel connection?

Instruction

1. Connect 2 bulbs in series connection, then measure the voltage and electric current of each bulb.

2. Connect 2 bulbs in parallel connection, then measure the voltage and electric current of each bulb.

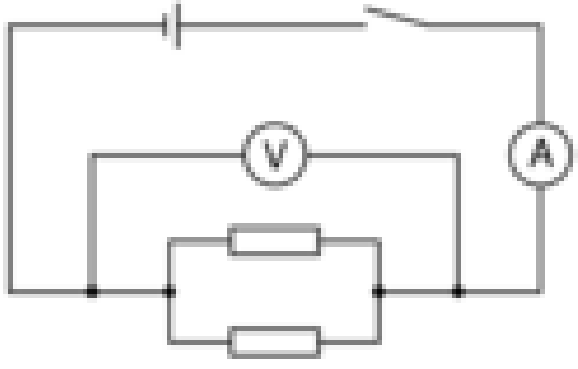
3. Compare the brightness of bulbs between the case in 1. and 2.

4. Conclusion

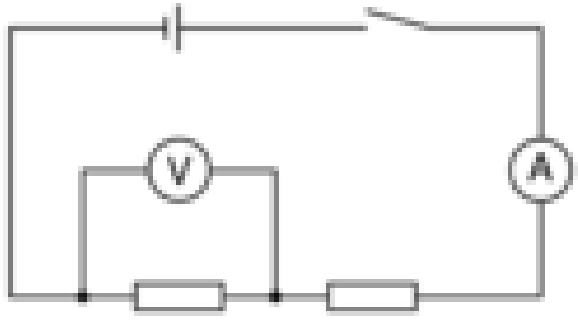
Inquiry Activity

In which circuit of bulbs are blighter? Why?

Let's measure the electric current and the voltage !



→ **Parallel connection**



→ **Series connection**

Workshop on Inquiry-Based Learning

Topics : Renewable Energy

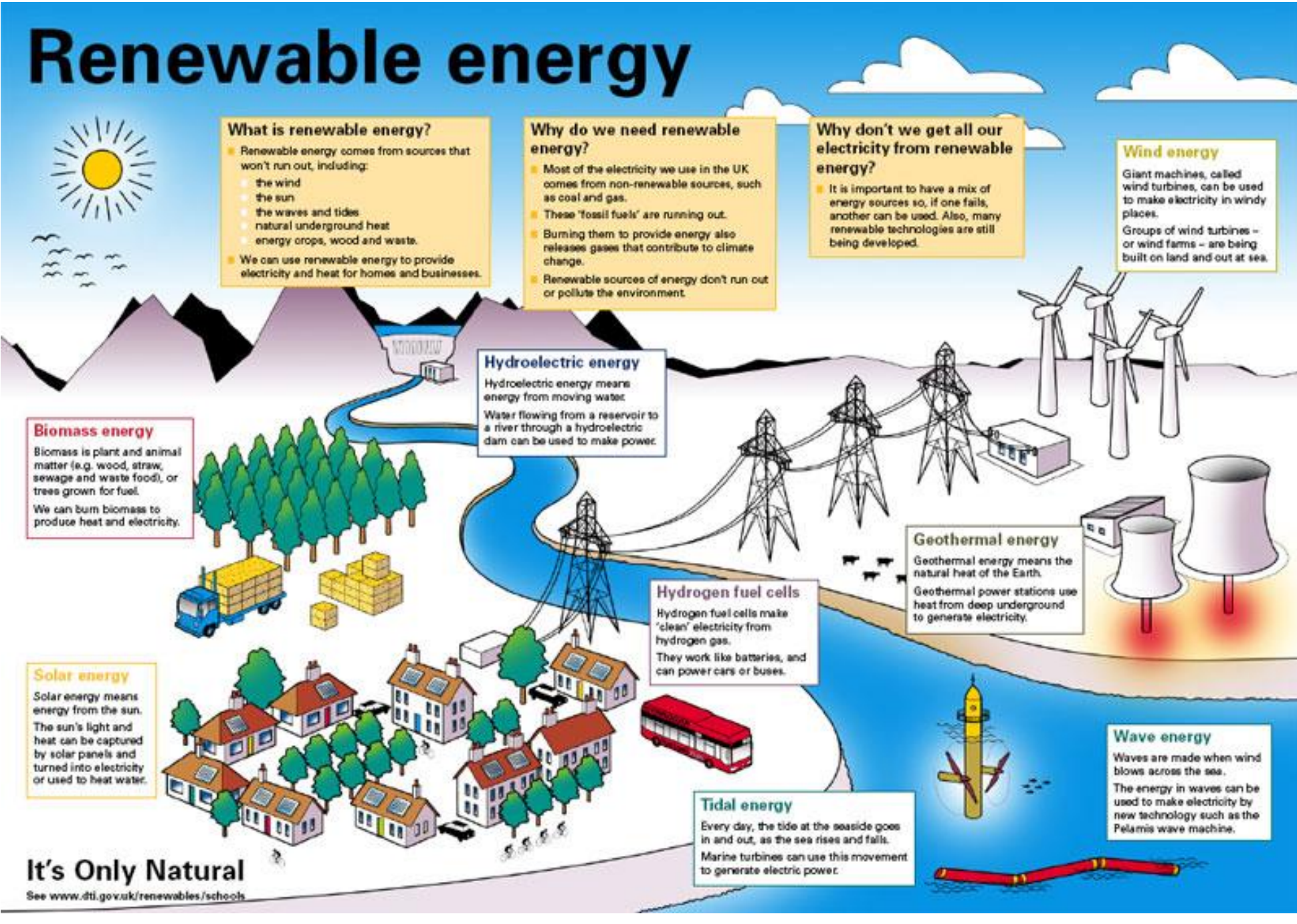
RECSAM Specialist Yuji OTSUKA

Introduction

Industrialization ➡ many problems

What caused these problems? ➡ Mainly CO_2

Renewable energy



What is renewable energy?

- Renewable energy comes from sources that won't run out, including:
  - the wind
  - the sun
  - the waves and tides
  - natural underground heat
  - energy crops, wood and waste.
- We can use renewable energy to provide electricity and heat for homes and businesses.

Why do we need renewable energy?

- Most of the electricity we use in the UK comes from non-renewable sources, such as coal and gas.
- These 'fossil fuels' are running out.
- Burning them to provide energy also releases gases that contribute to climate change.
- Renewable sources of energy don't run out or pollute the environment.

Why don't we get all our electricity from renewable energy?

- It is important to have a mix of energy sources so, if one fails, another can be used. Also, many renewable technologies are still being developed.

Wind energy

Giant machines, called wind turbines, can be used to make electricity in windy places.

Groups of wind turbines – or wind farms – are being built on land and out at sea.

Hydroelectric energy

Hydroelectric energy means energy from moving water.

Water flowing from a reservoir to a river through a hydroelectric dam can be used to make power.

Biomass energy

Biomass is plant and animal matter (e.g. wood, straw, sewage and waste food), or trees grown for fuel.

We can burn biomass to produce heat and electricity.

Geothermal energy

Geothermal energy means the natural heat of the Earth.

Geothermal power stations use heat from deep underground to generate electricity.

Hydrogen fuel cells

Hydrogen fuel cells make 'clean' electricity from hydrogen gas.

They work like batteries, and can power cars or buses.

Solar energy

Solar energy means energy from the sun.

The sun's light and heat can be captured by solar panels and turned into electricity or used to heat water.

Wave energy

Waves are made when wind blows across the sea.

The energy in waves can be used to make electricity by new technology such as the Pelamis wave machine.

Tidal energy

Every day, the tide at the seaside goes in and out, as the sea rises and falls.

Marine turbines can use this movement to generate electric power.

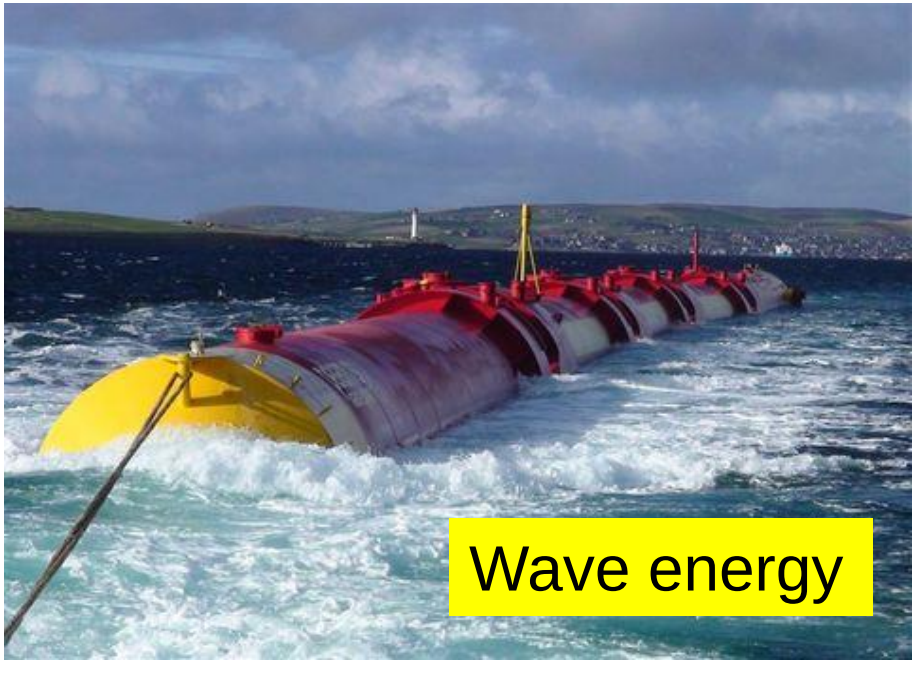
It's Only Natural

See www.dti.gov.uk/renewables/schools


Wind energy


Solar energy


Geothermal energy


Wave energy

Scientific Process

How can we produce electricity?

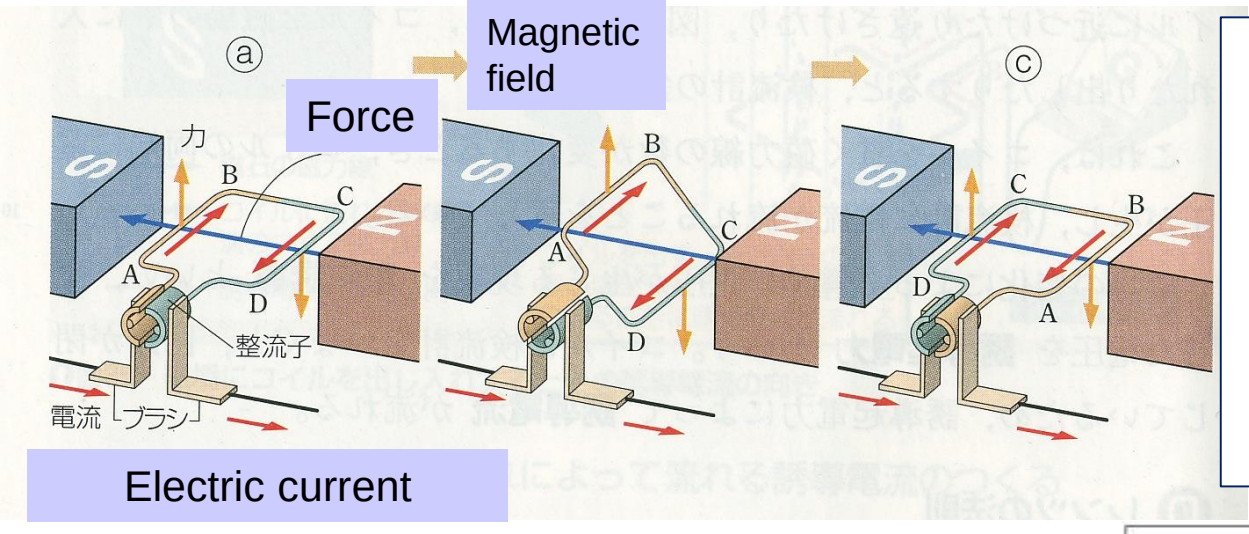
1. Ask

To find the best way to produce electricity !

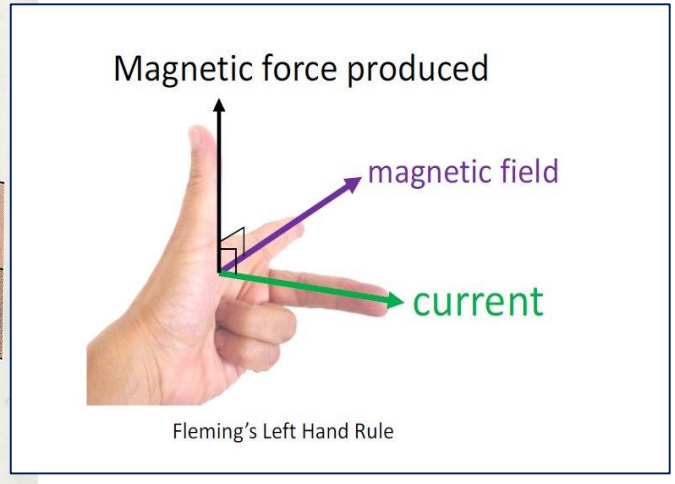
2.Purpose

3.Research

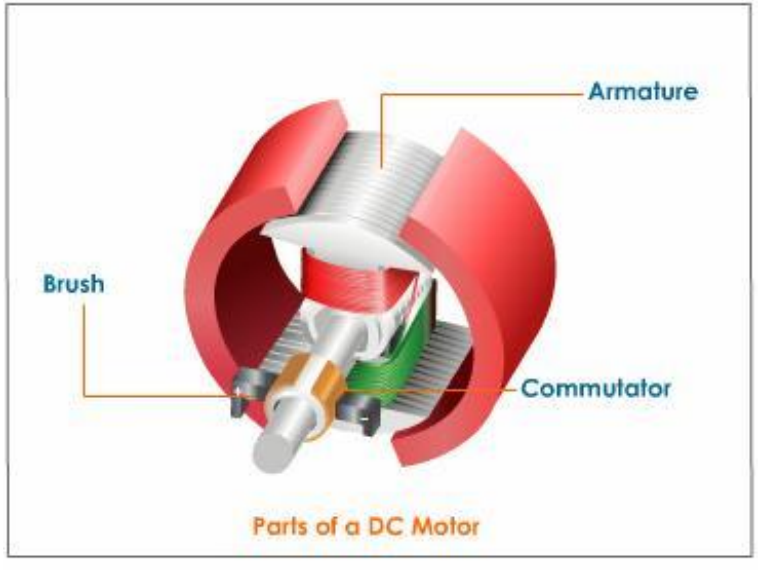
Principle of Motor



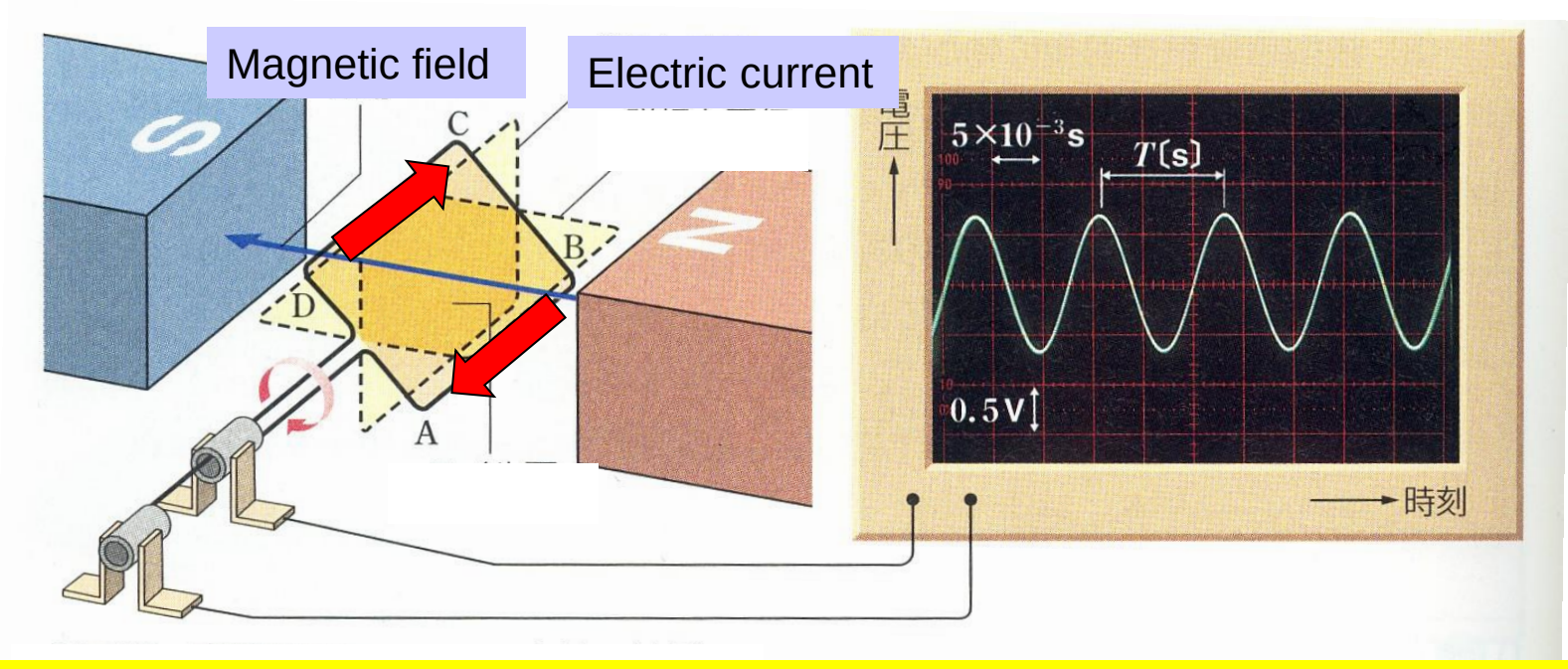
Electric current



Electric current → Magnetic field → Force



Principle of power generating

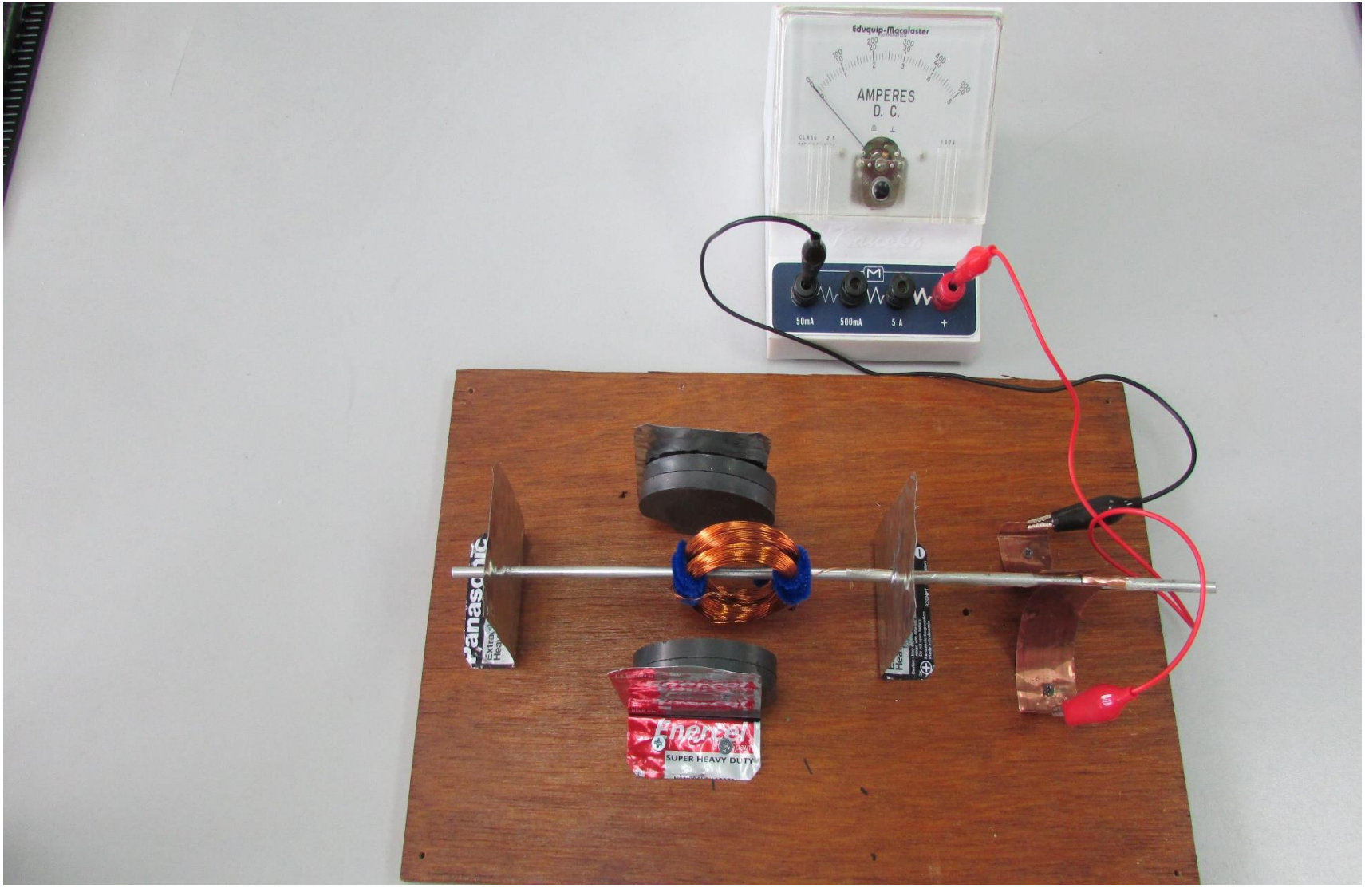


Mechanical Energy ➡ **Electromagnetic Induction**

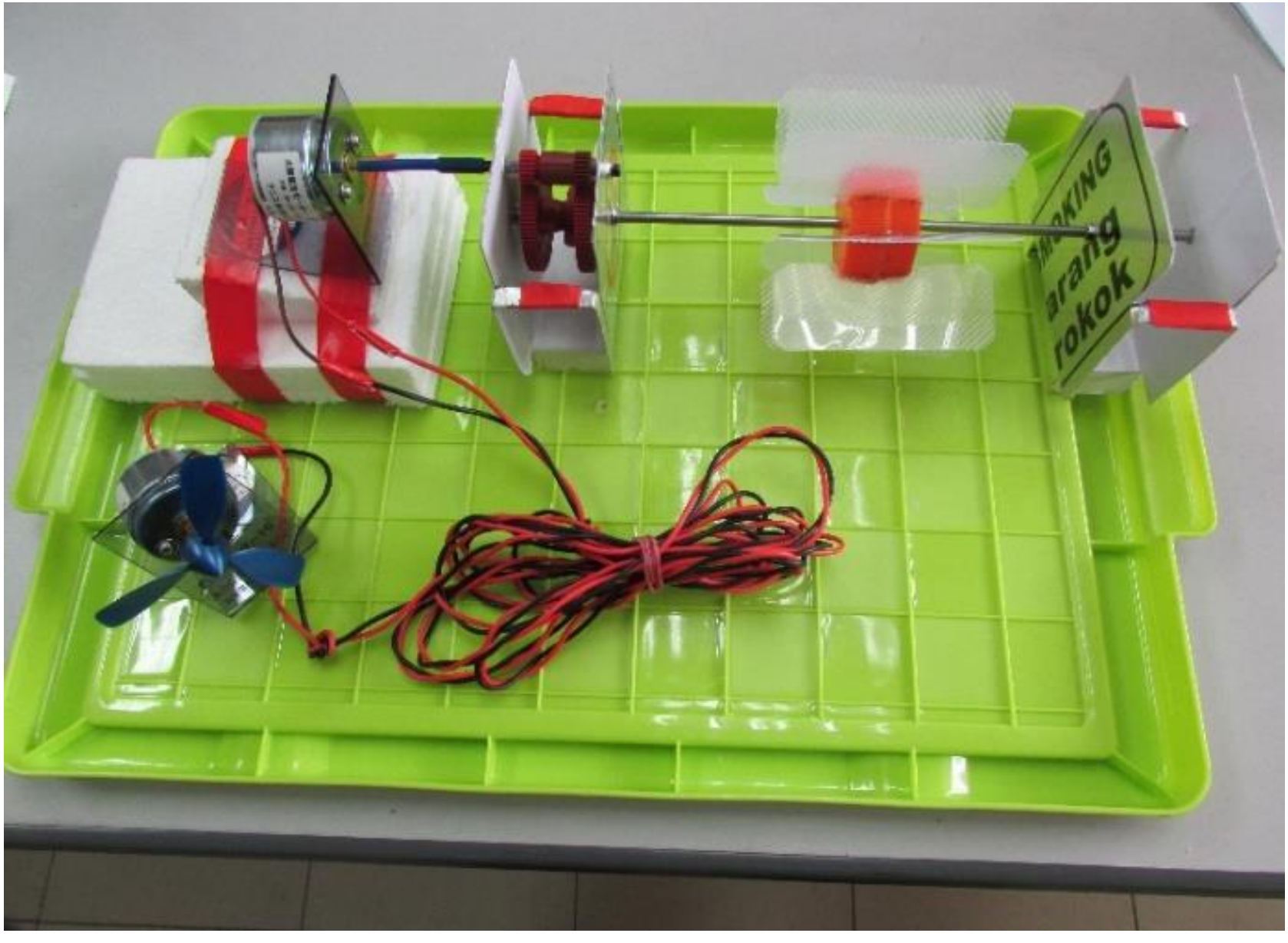
⬇

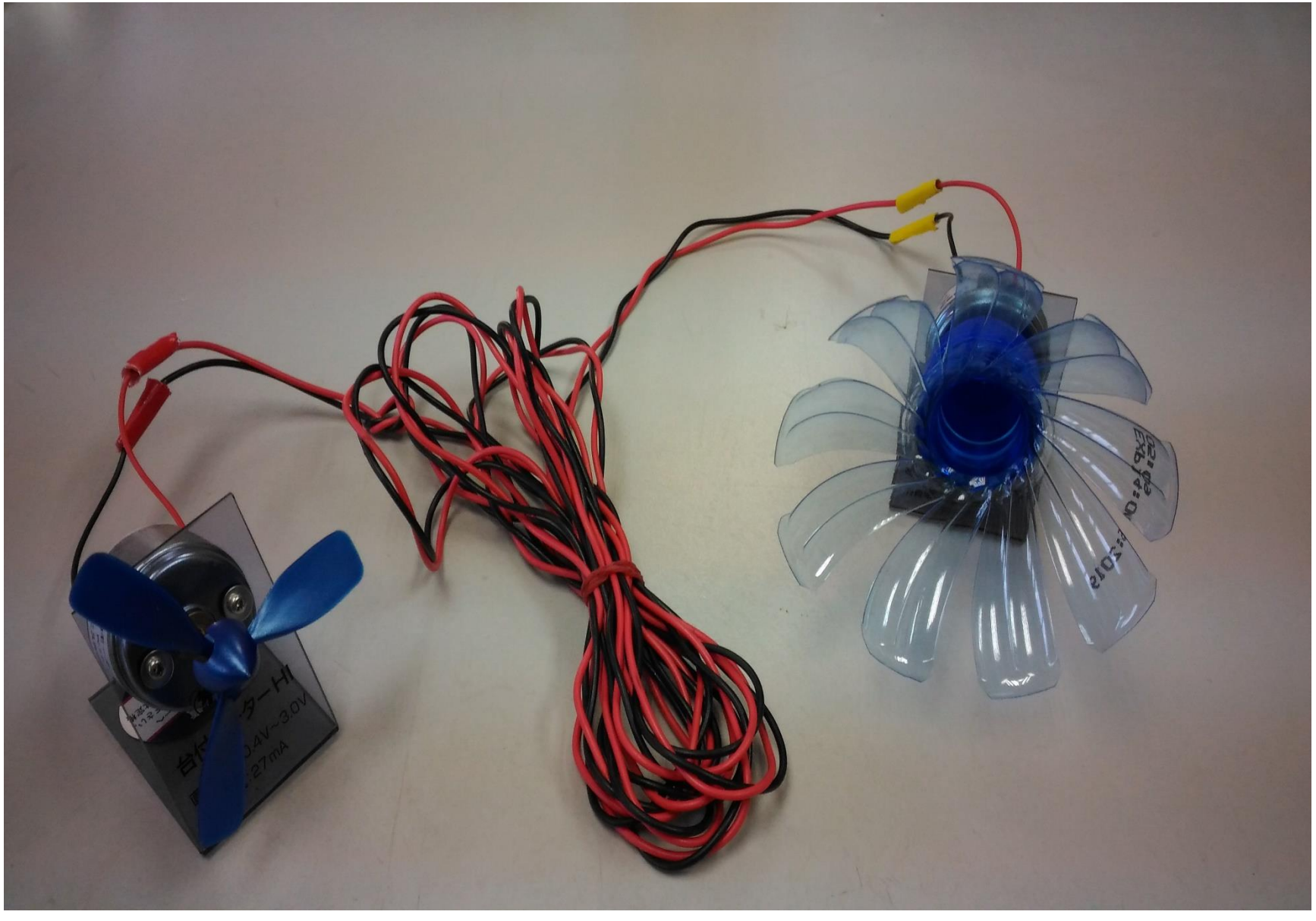
Electric Energy

Generator （Motor)



Hydro Power Generator





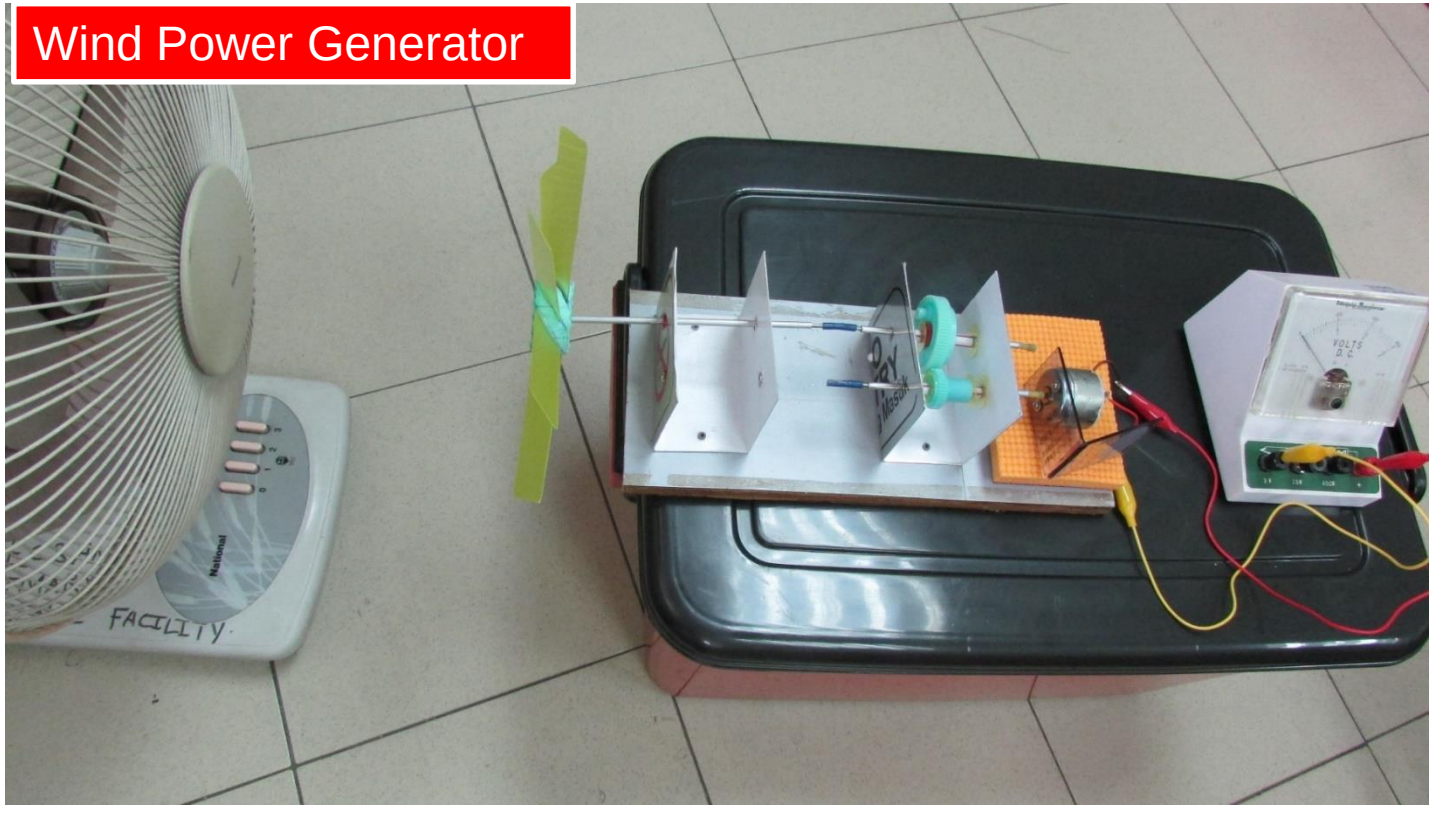
Wind-powered generator!

Chose a solution

Objective

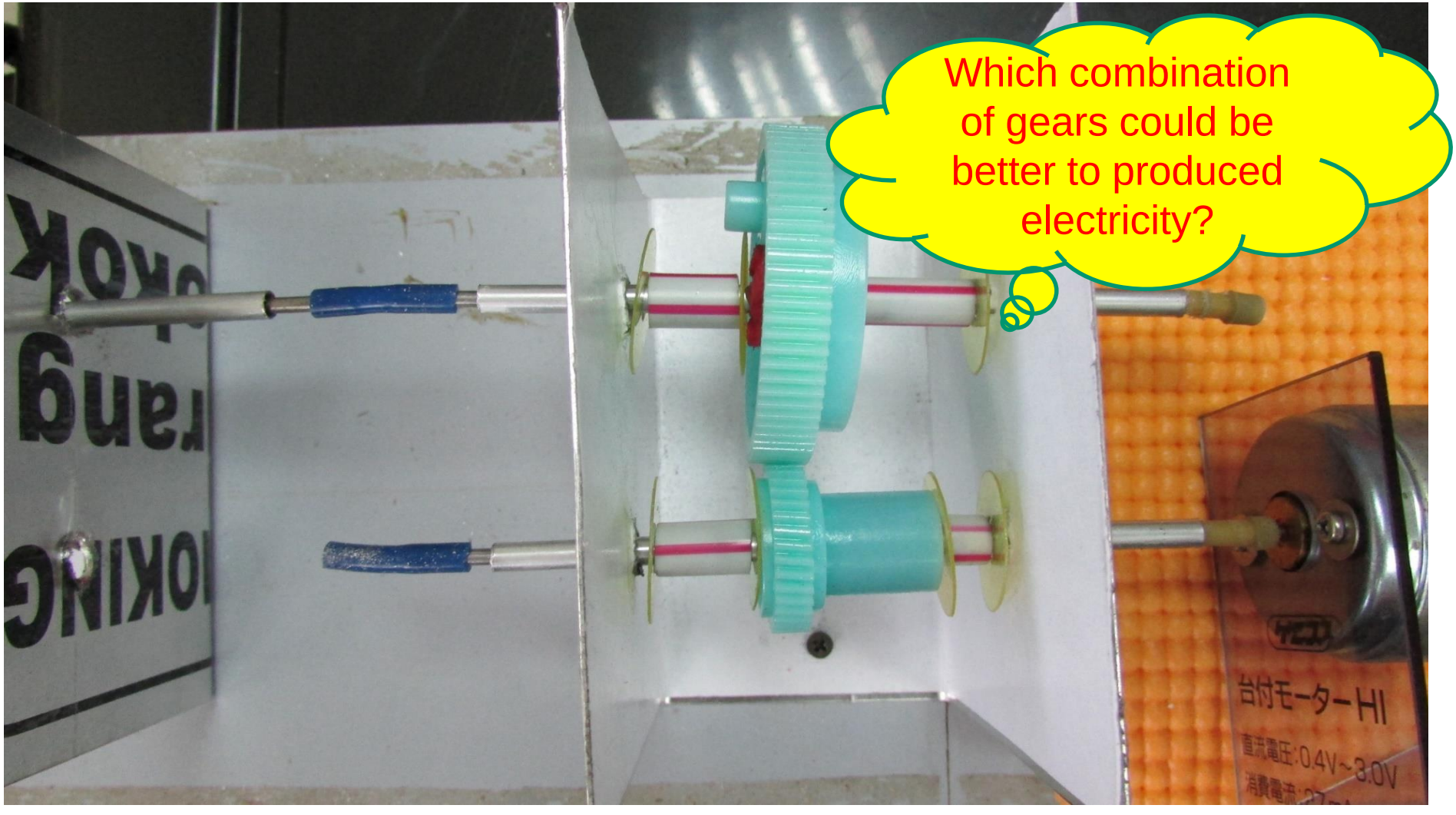
To find the best way in which electricity could be produced as much as possible!

Wind Power Generator



4. Hypothesis

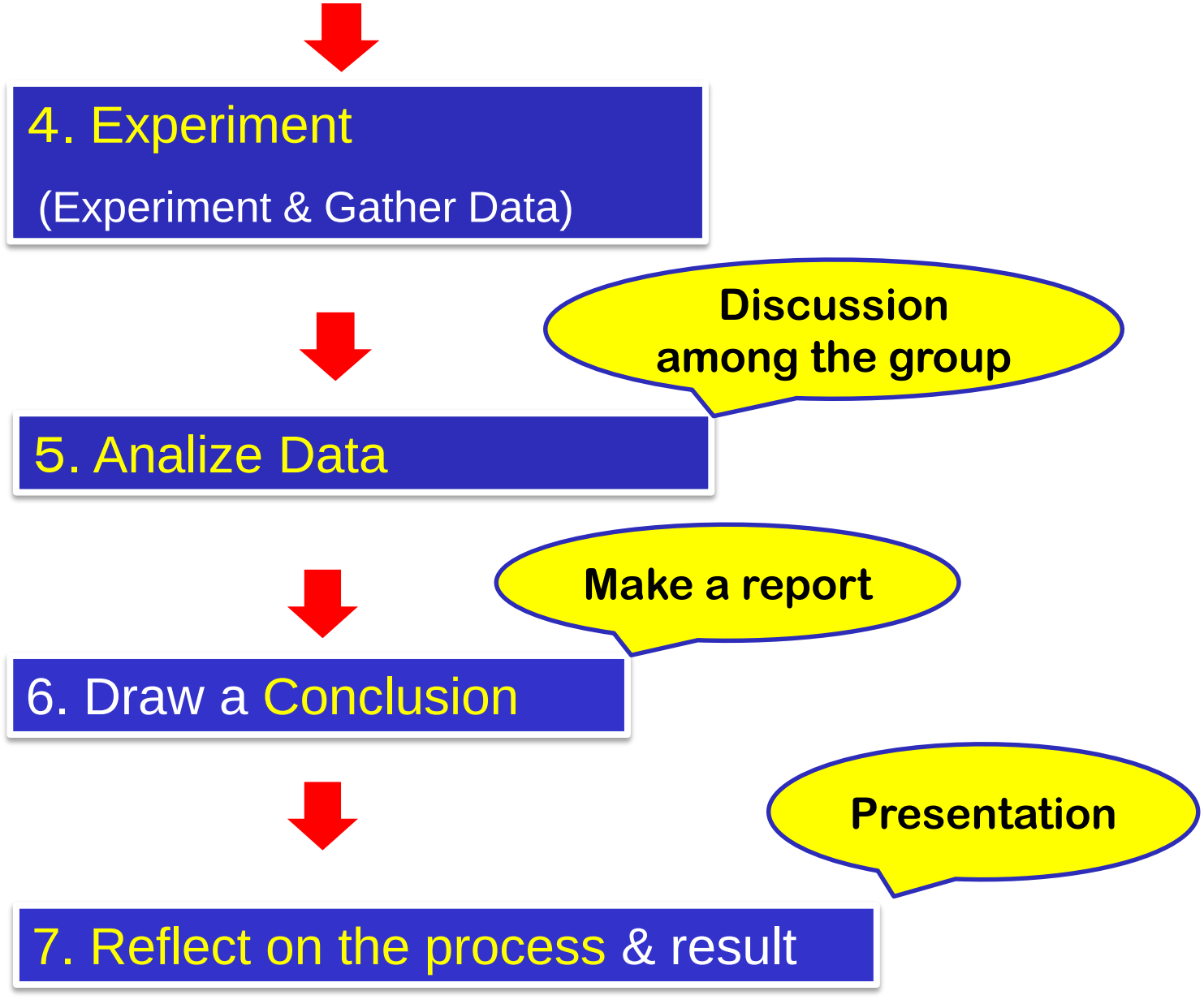
Idea ➡ Gear: Big gear to wind-mills, small gear to moto?



4. Hypothesis

What design of Wind-mills could be better to produced electricity?

Idea 1	Angle: Big angle is better?
Idea 2	Size: Large blades are better?
Idea 3	Shape: Many blades are better?

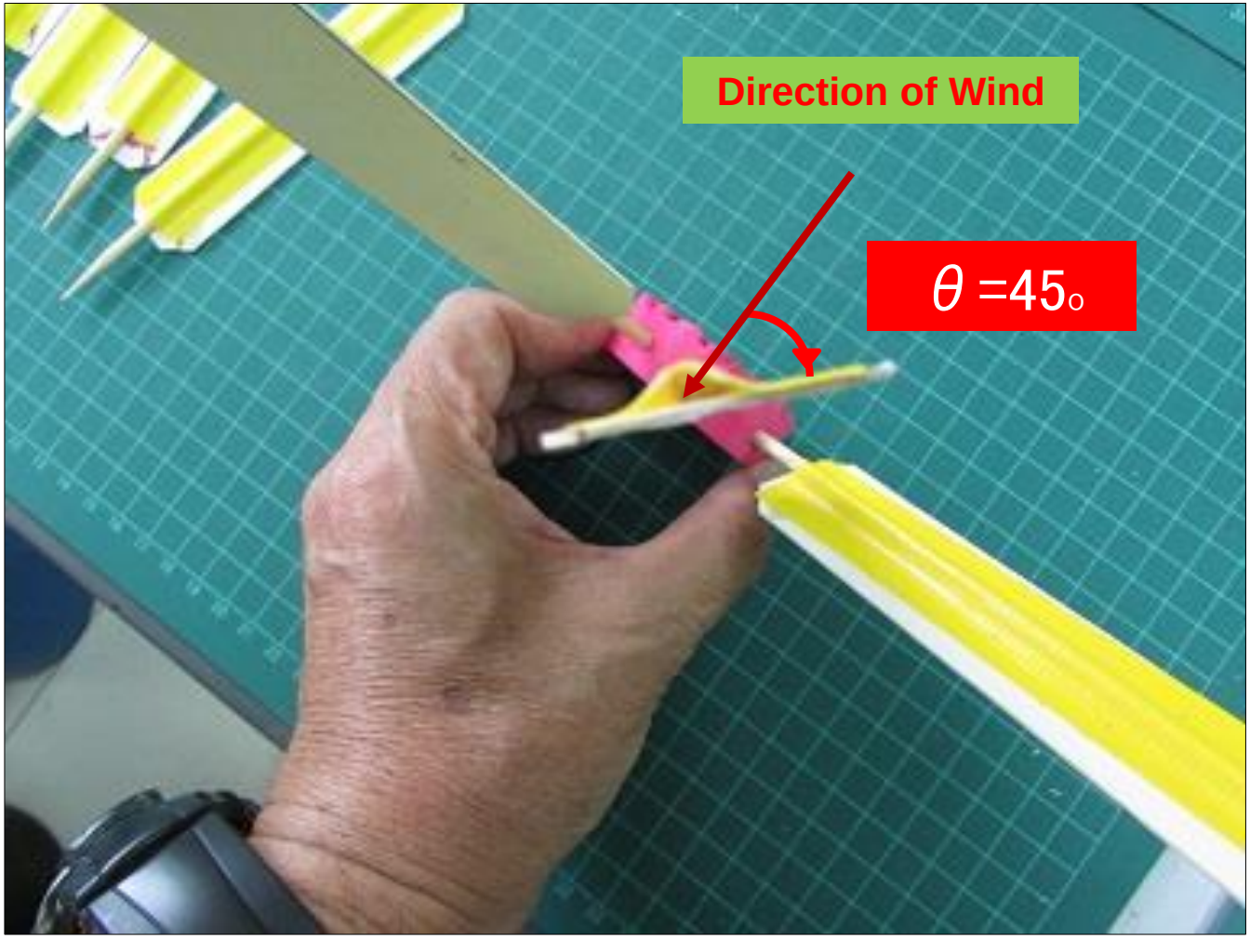

4. Experiment
(Experiment & Gather Data)
Discussion among the group
5. Analize Data
Make a report
6. Draw a Conclusion
Presentation
7. Reflect on the process & result

Presentation Time!

Present the results of your group based on DATA

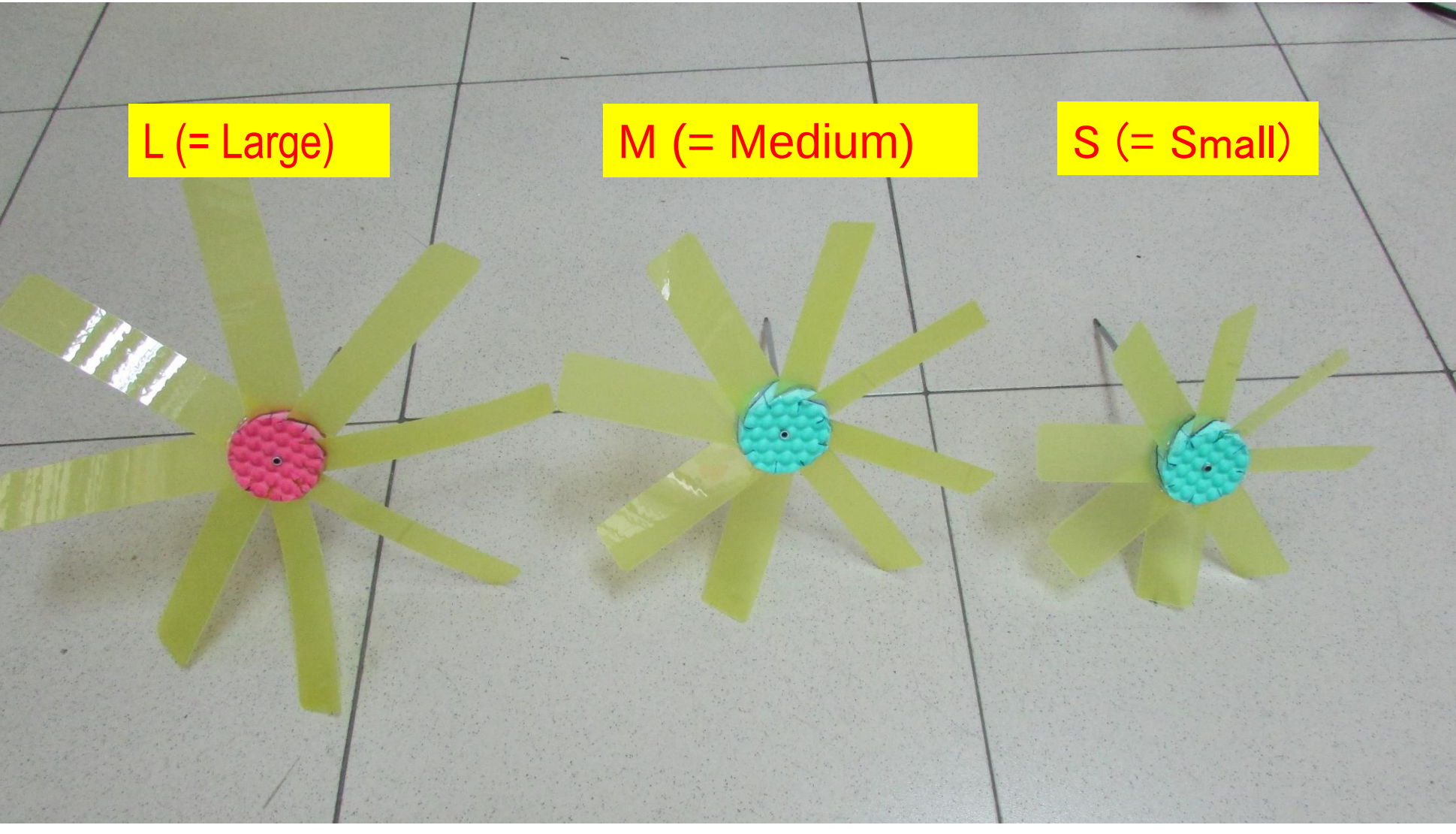
Example

Angle of blade

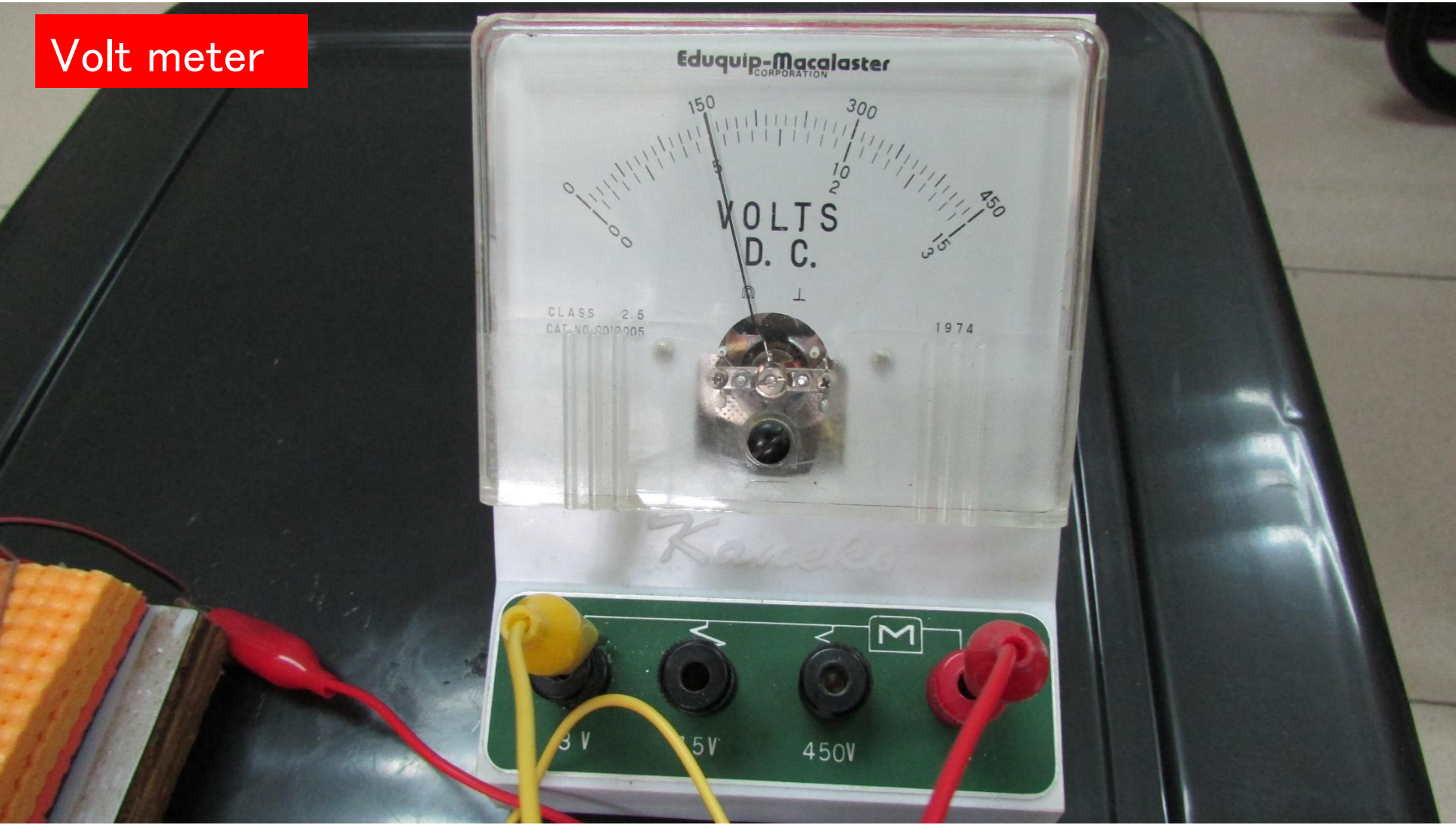


Example

Size of blades



Experiment & Gather data



Tester

AM
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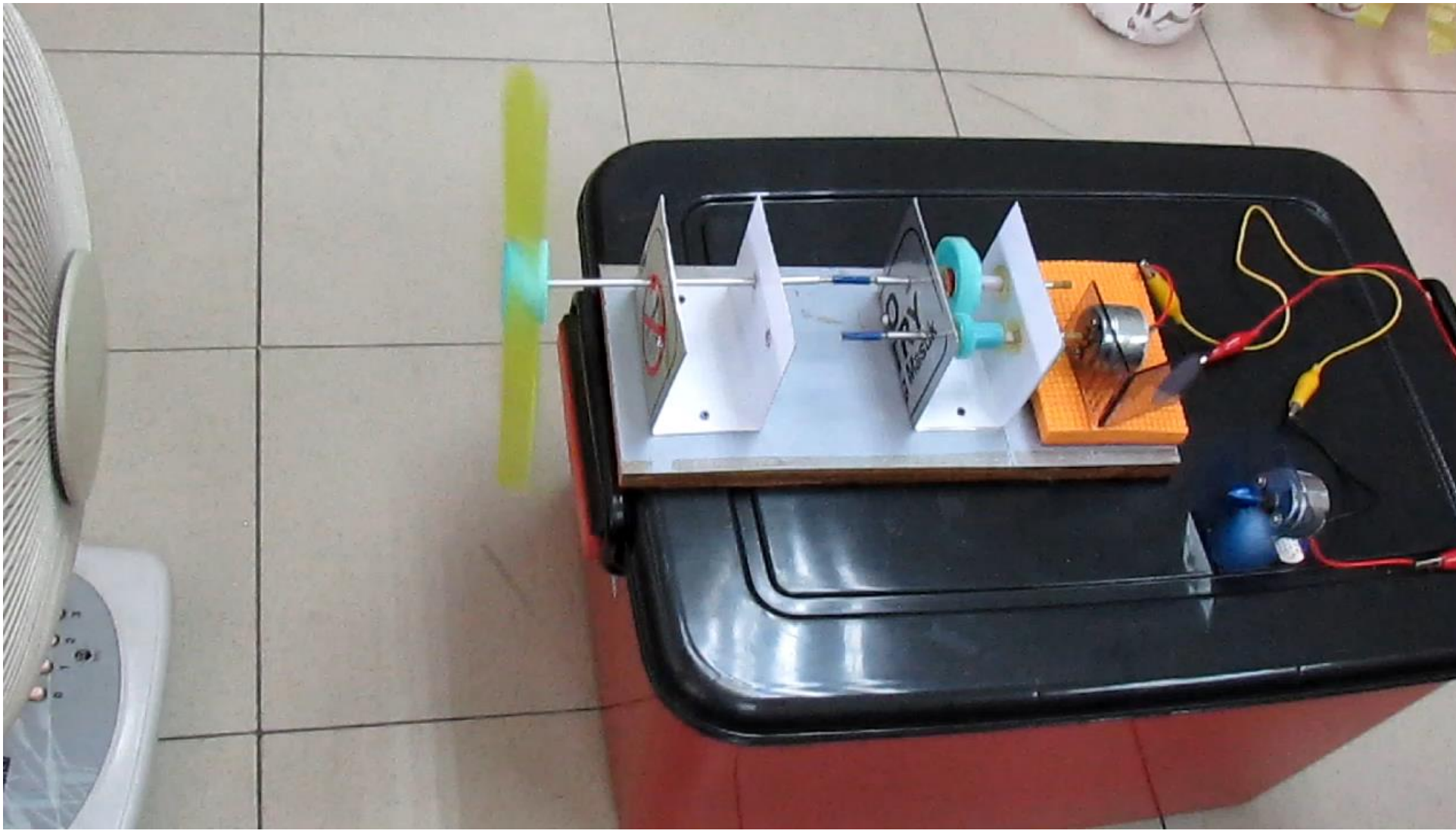
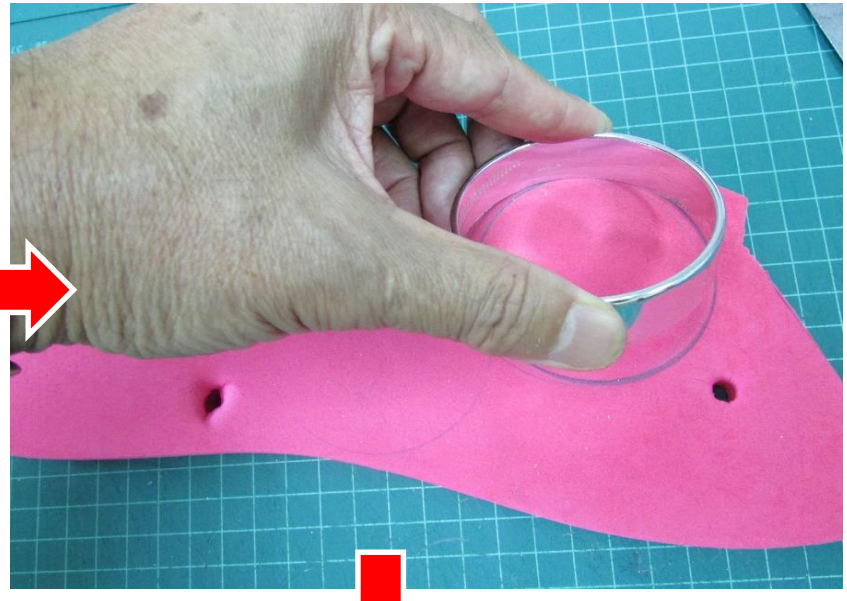
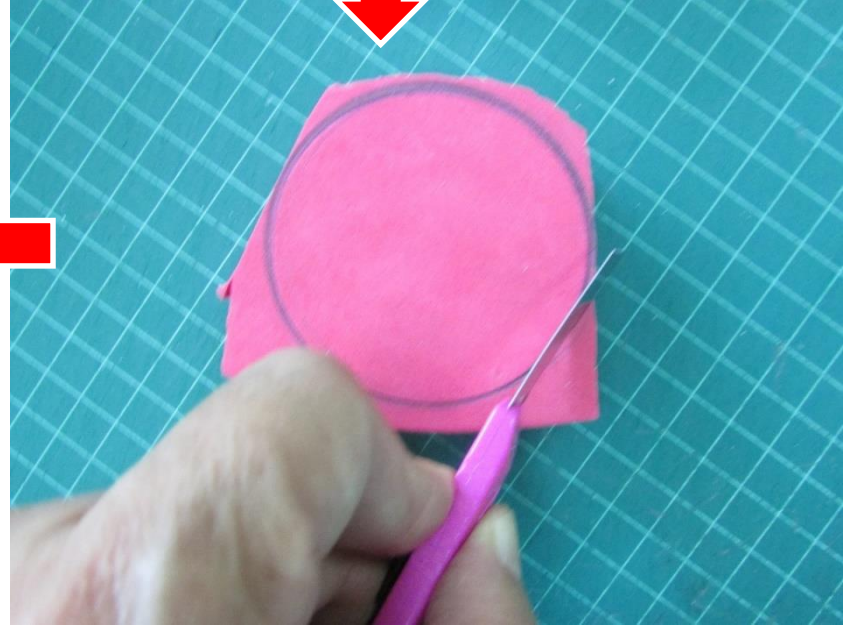
NCE FACILITY

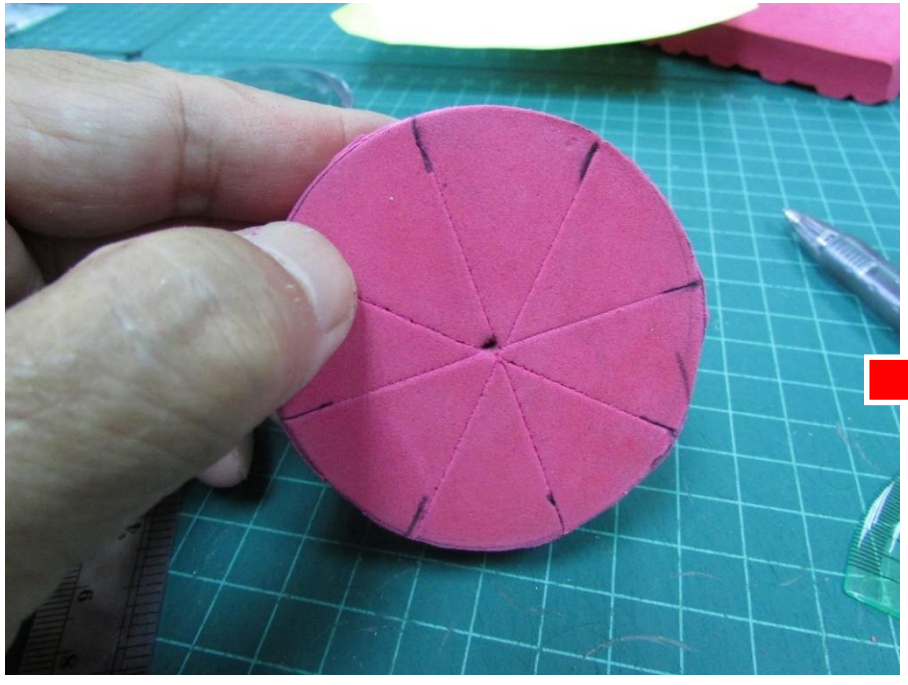


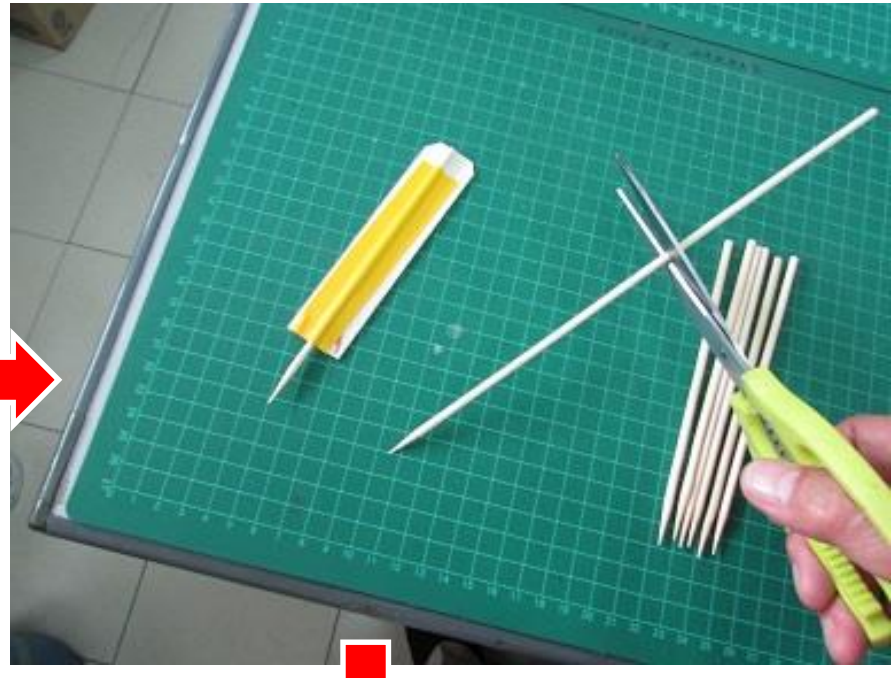
How to make

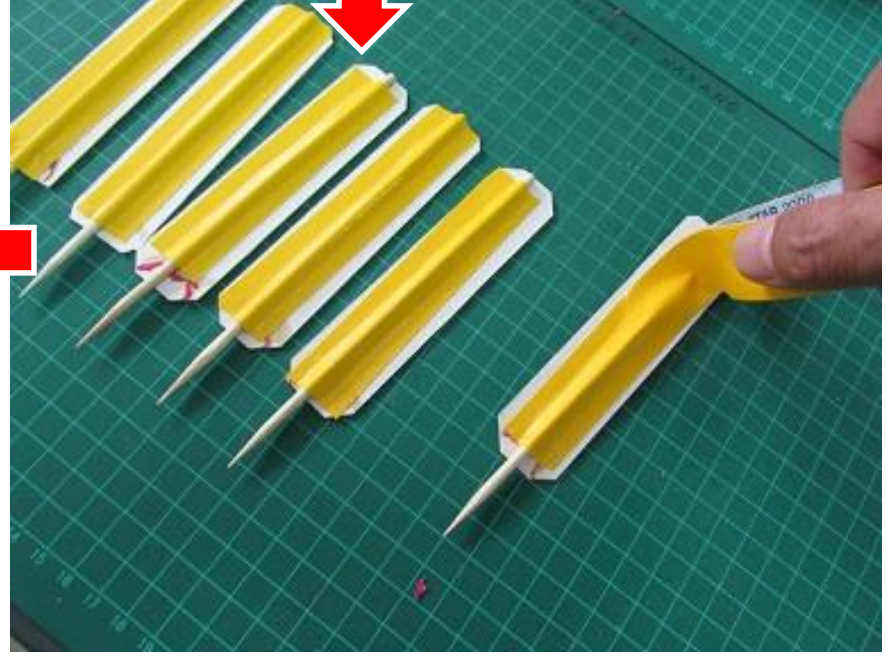
Wind mills -part

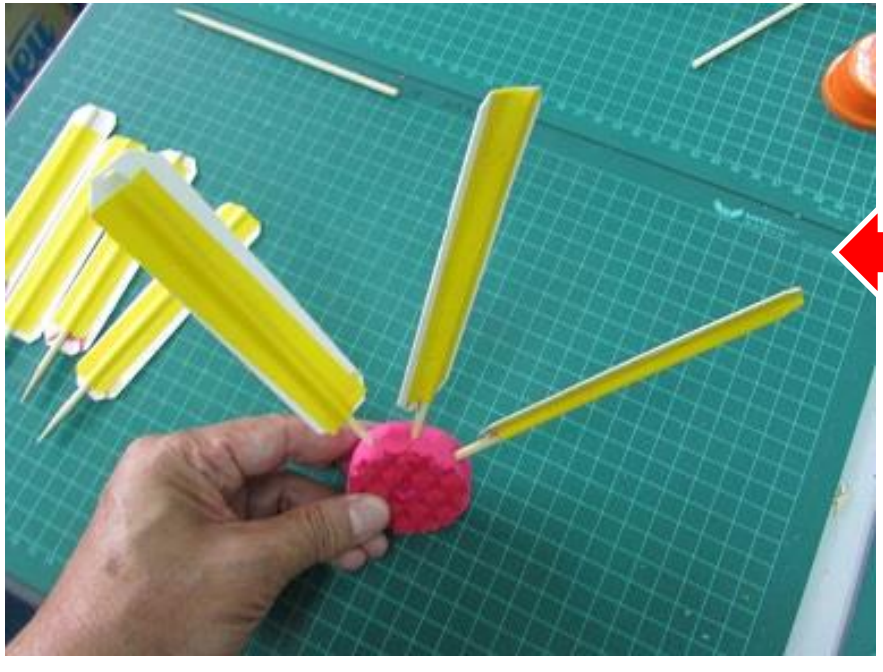


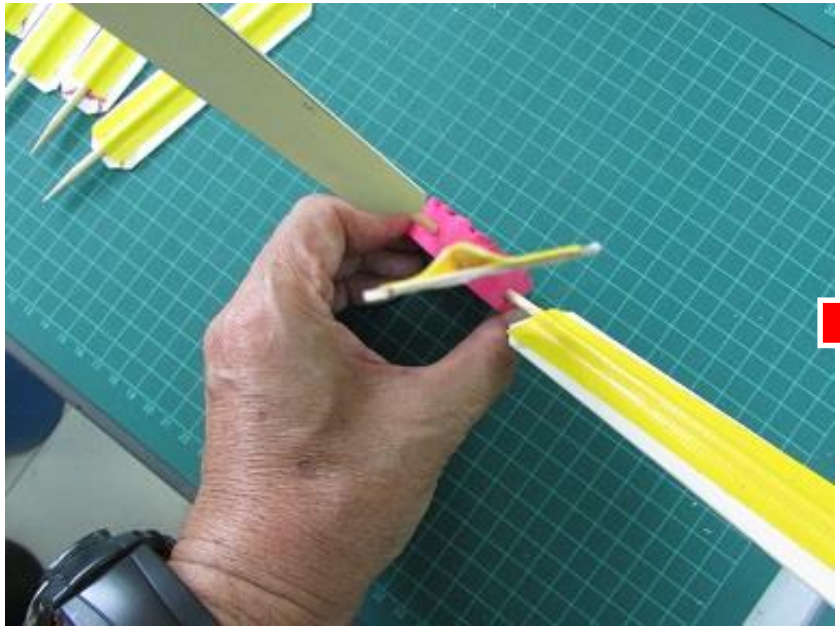


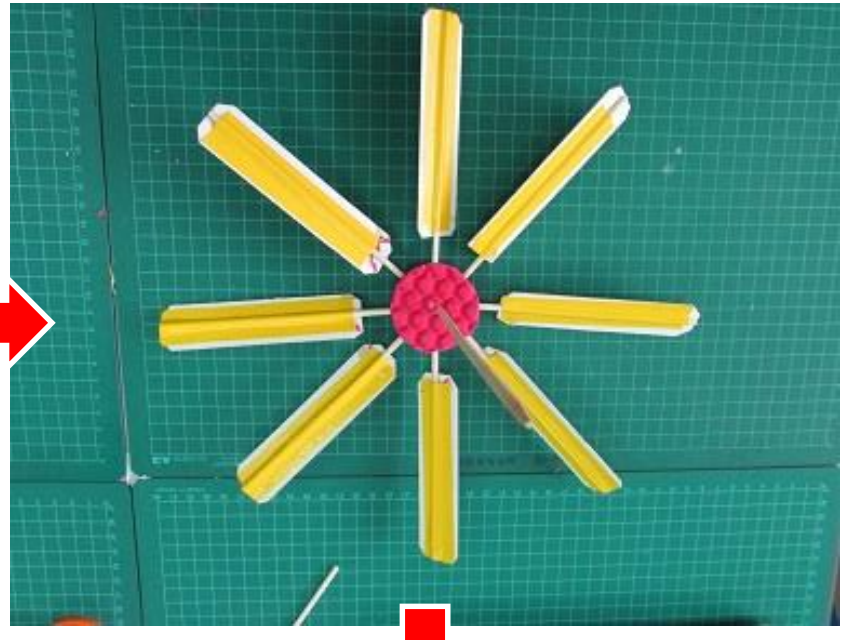


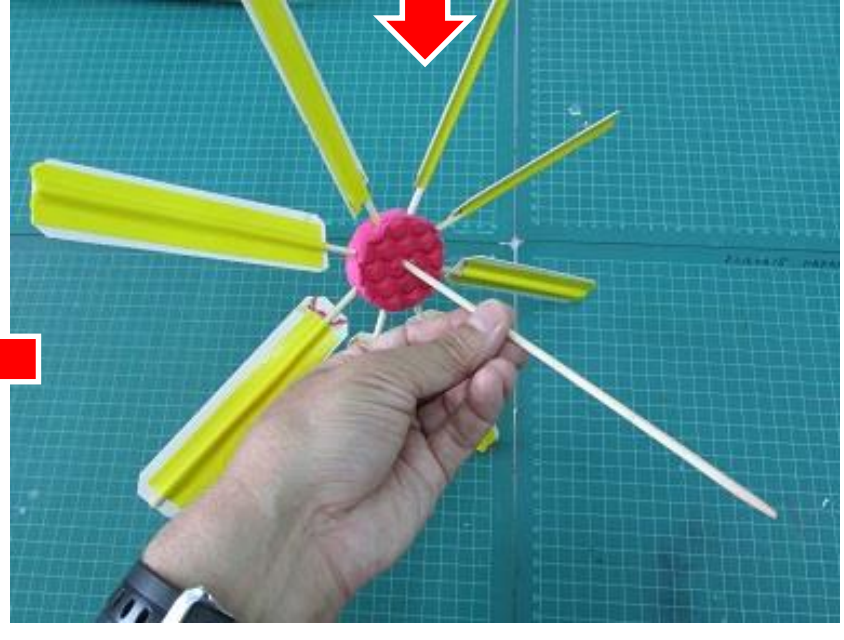


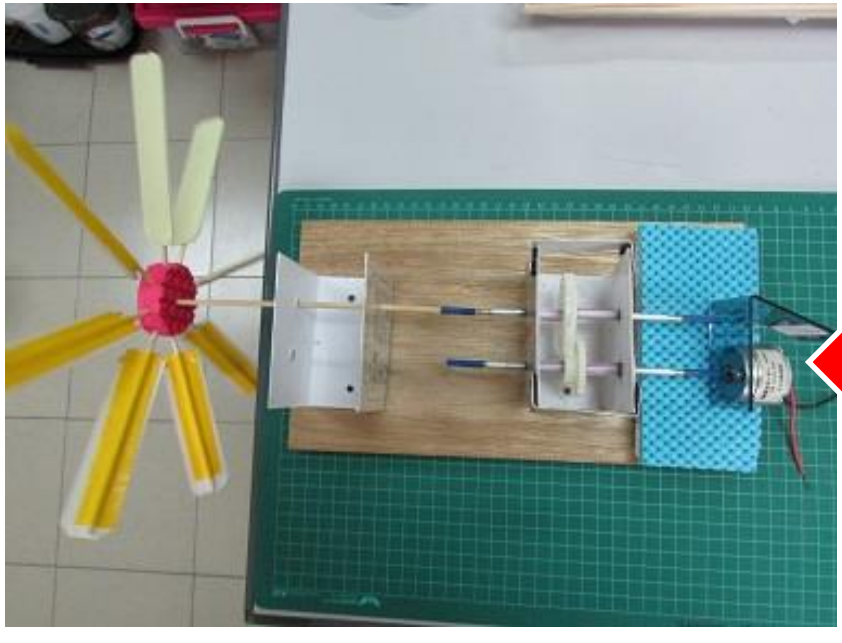




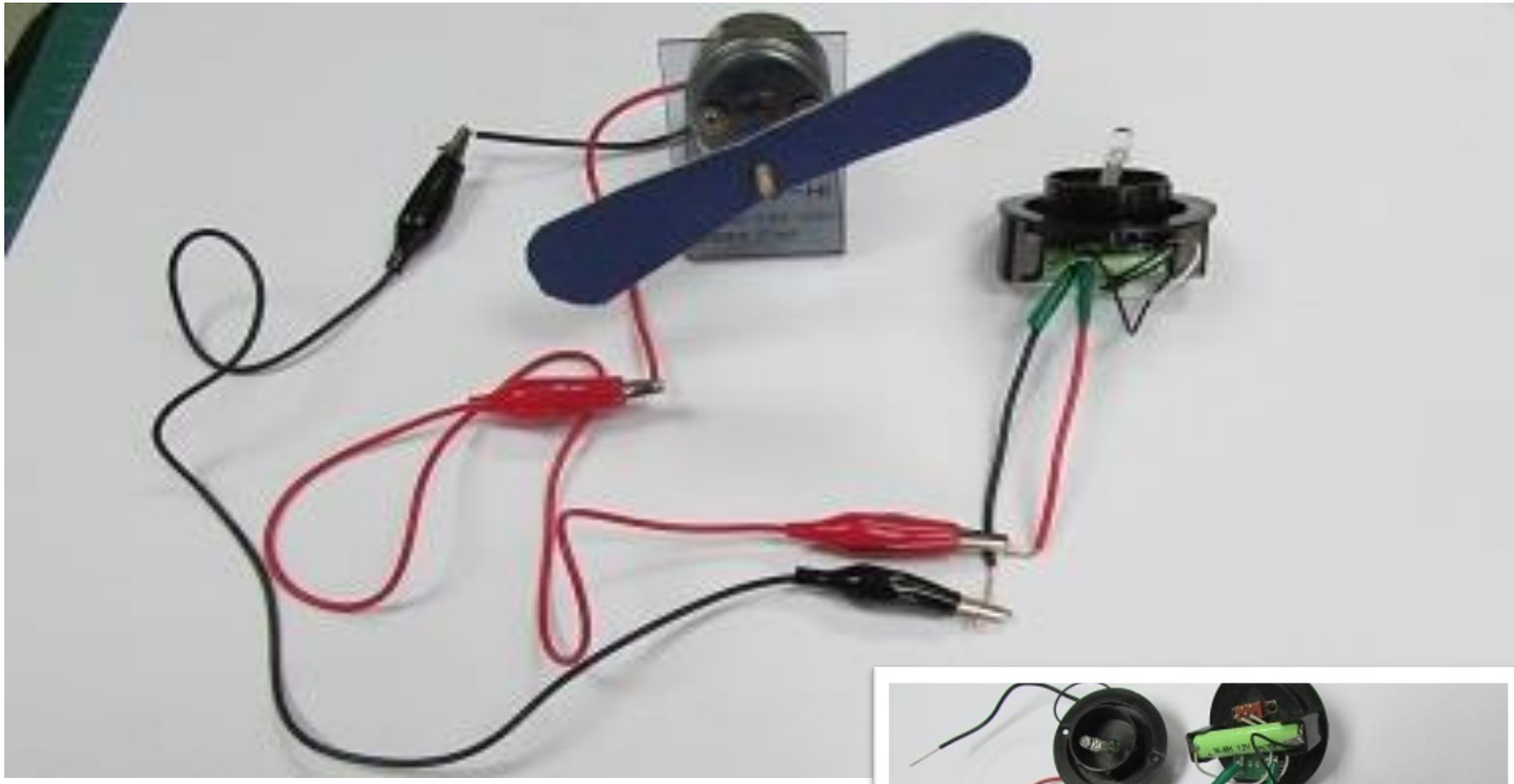


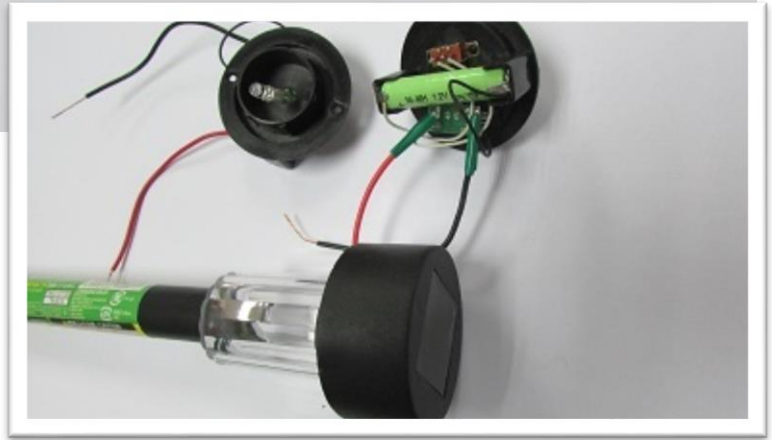






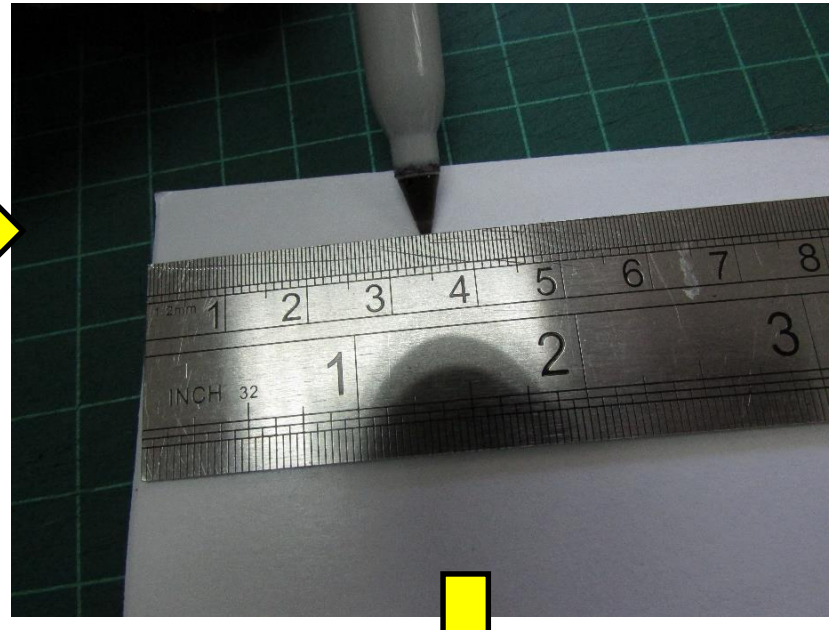
Battery charger

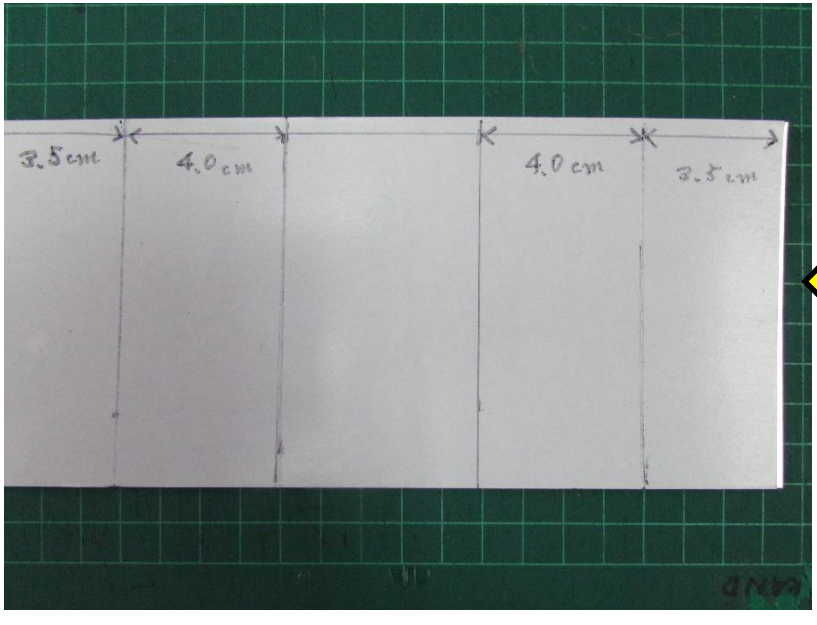


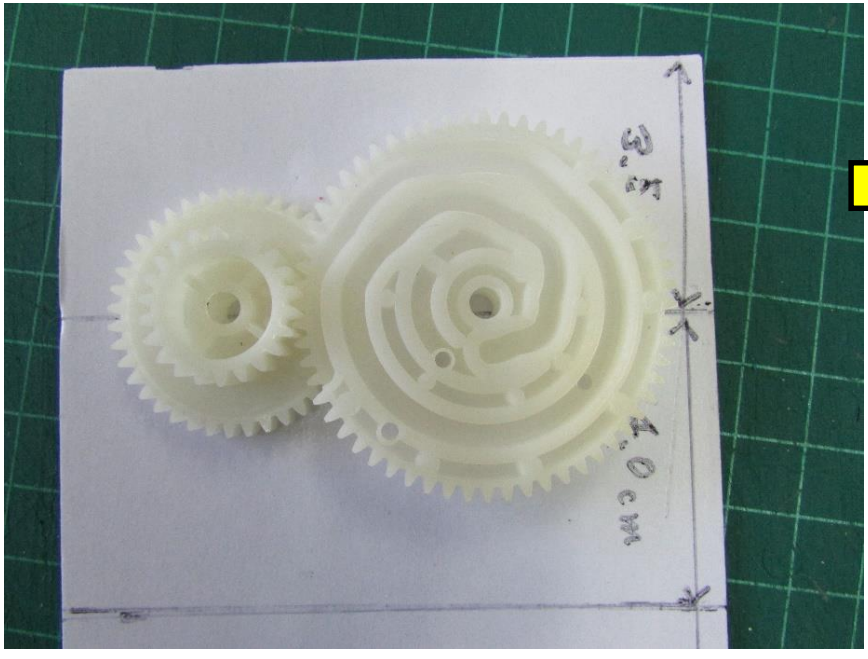


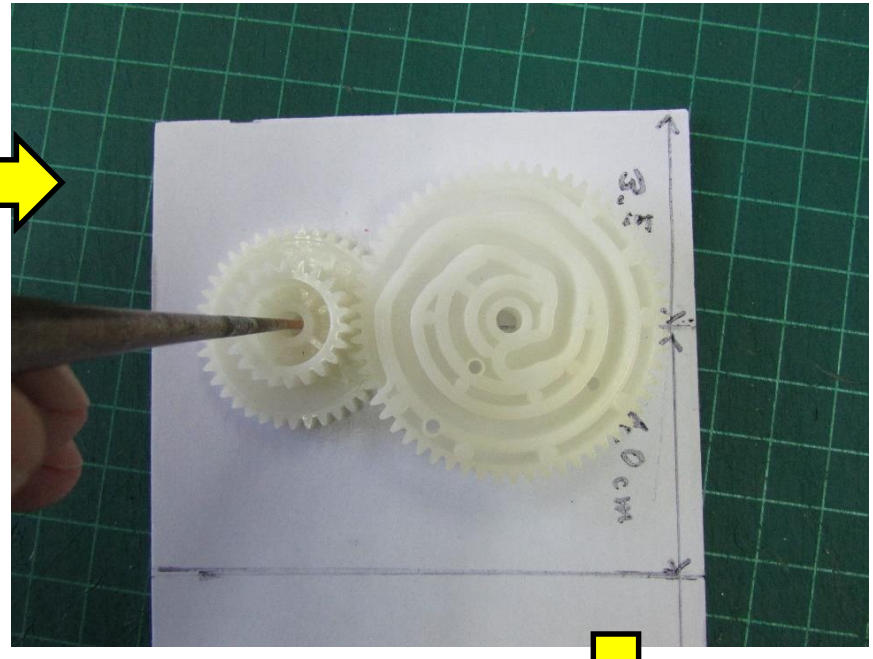
How to make

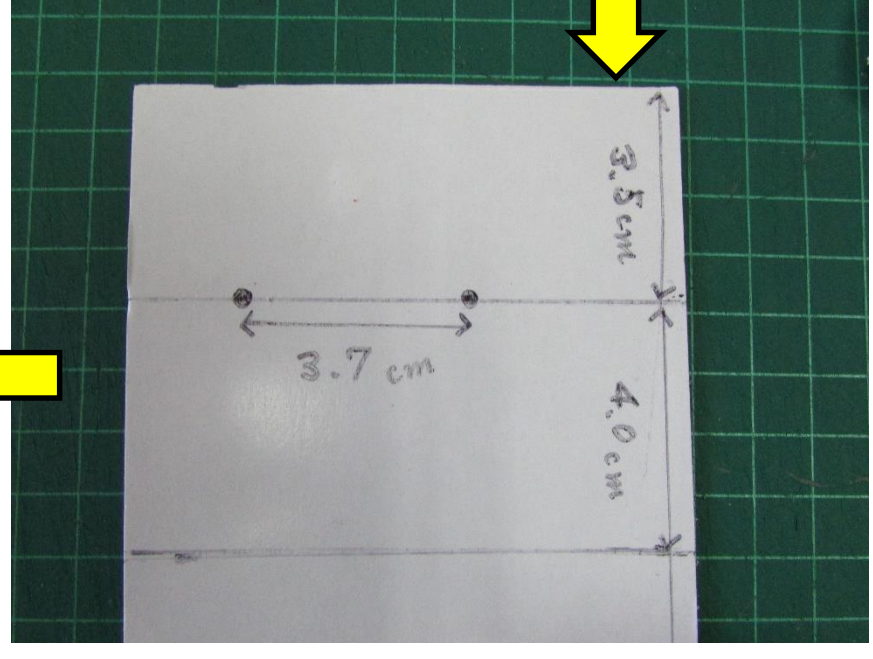
Gear-part

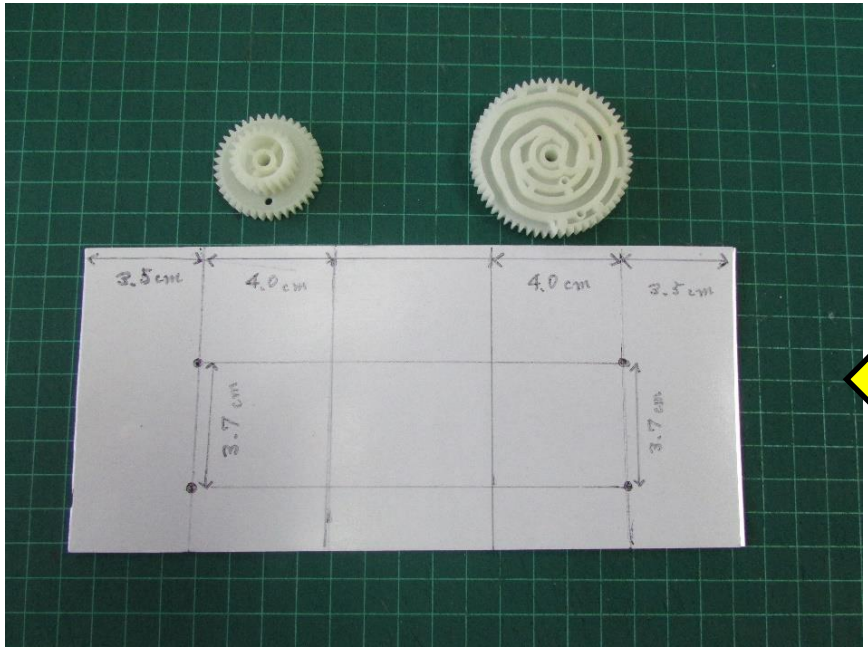





3.5cm
4.0cm

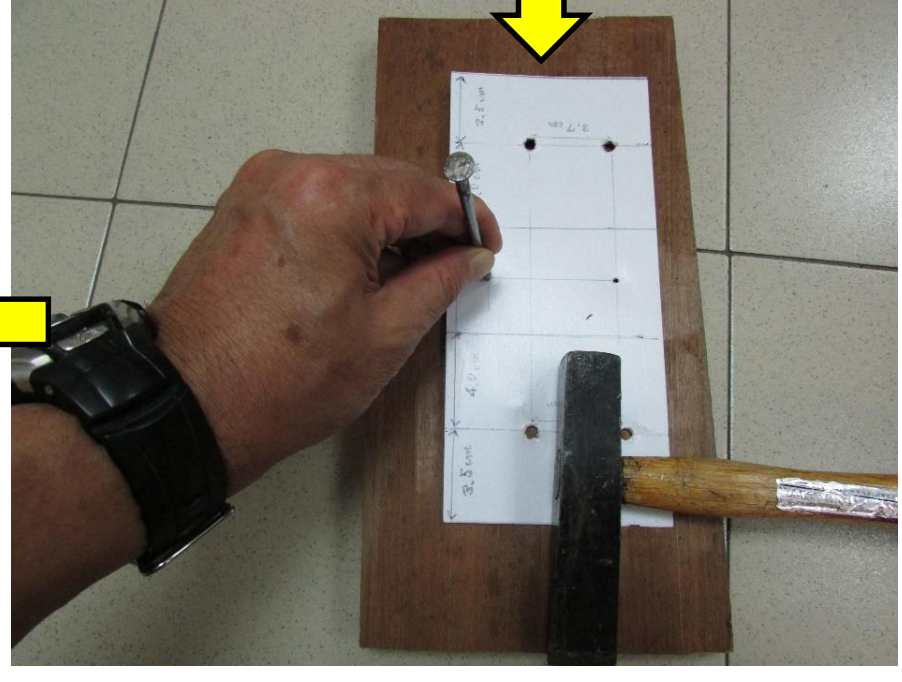

3.5cm
4.0cm

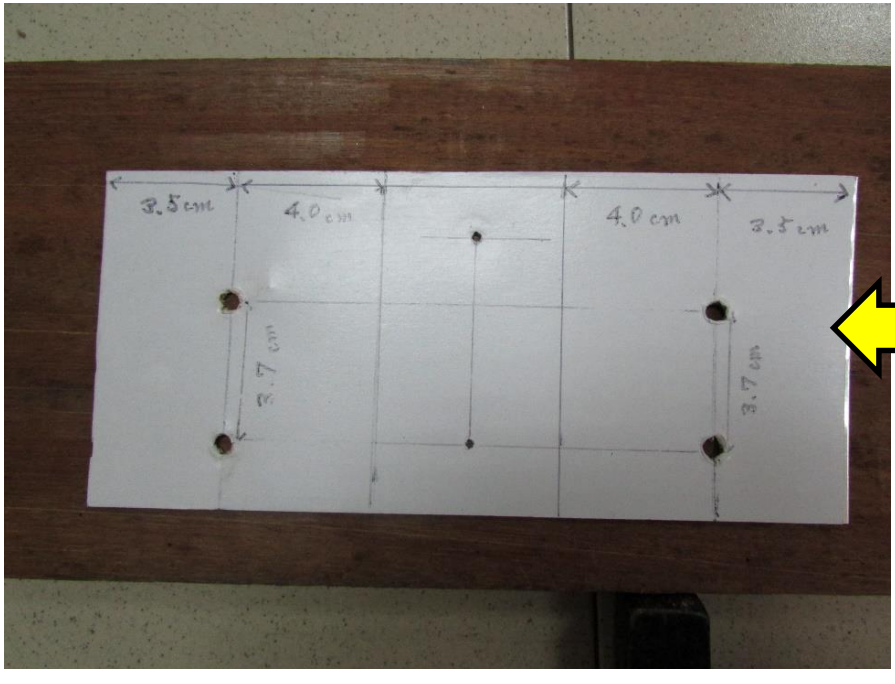

3.5cm
3.7 cm
4.0cm

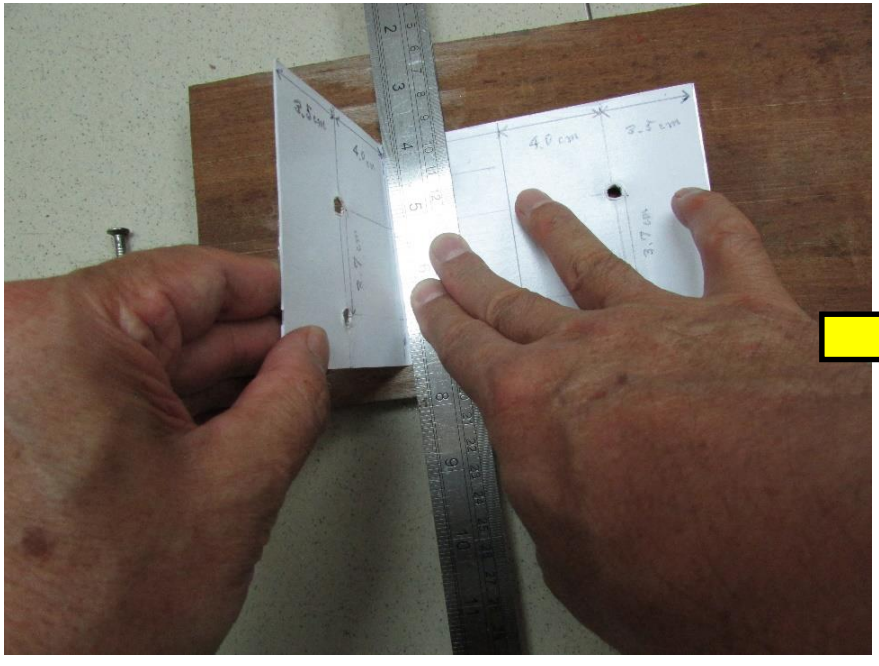

3.5cm
4.0cm
4.0cm
3.5cm
3.7 cm
3.7 cm

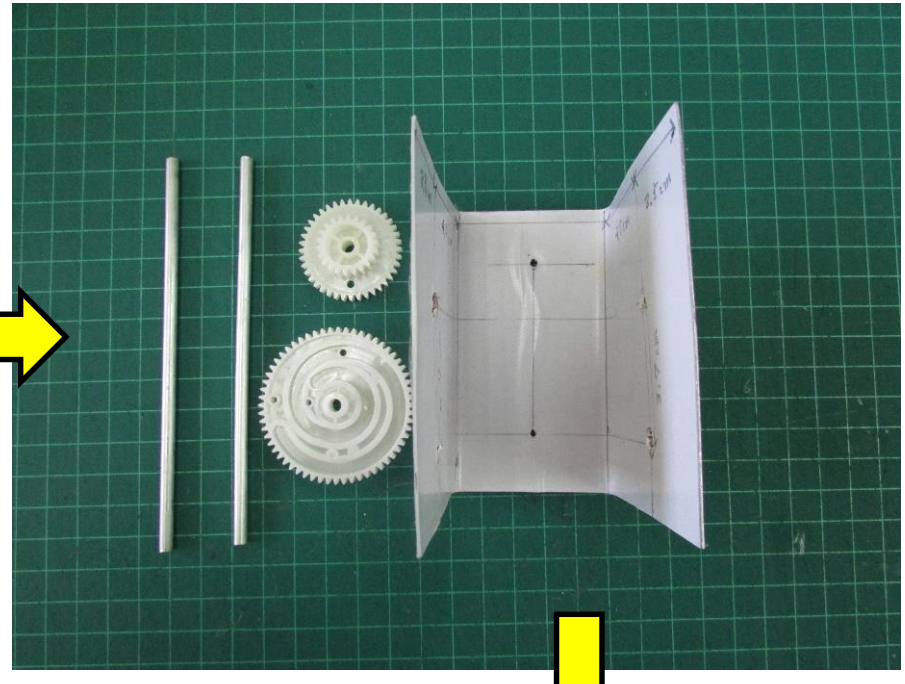

3.7 cm
3.7 cm

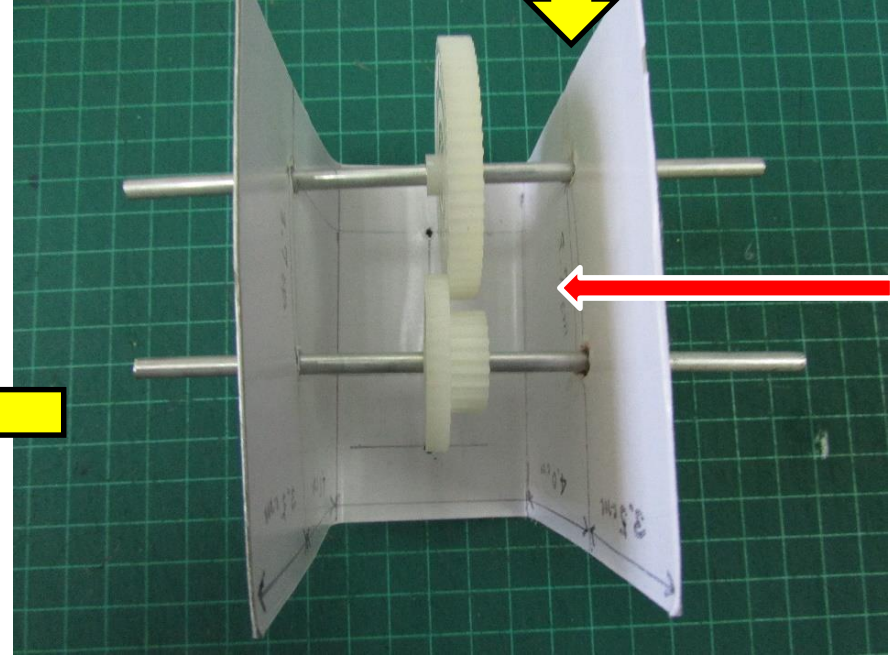

ONLY

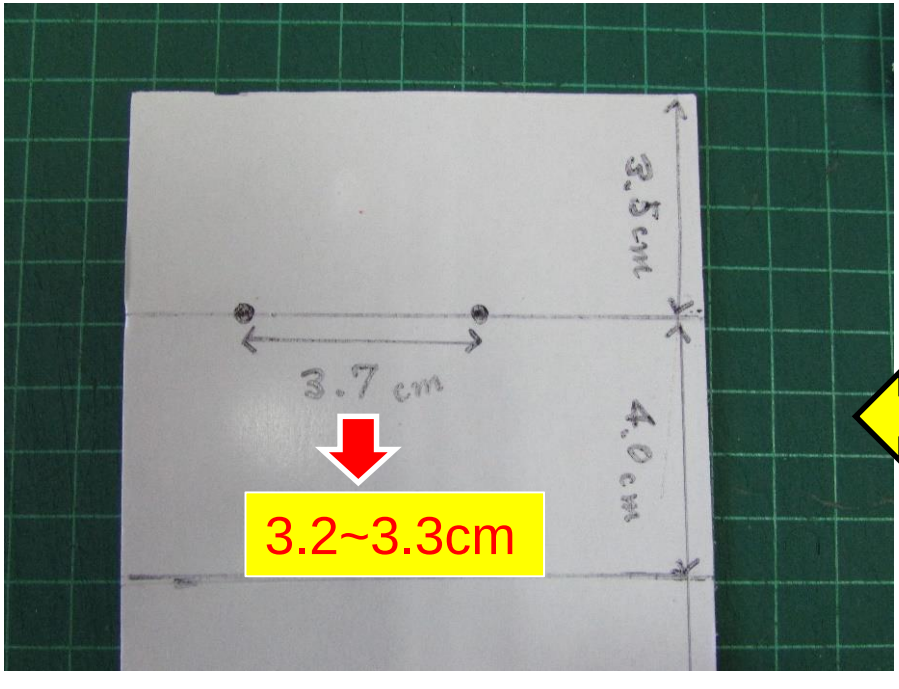

3.5 cm


3.5cm
4.0 cm
4.0 cm
3.5 cm
3.7 cm
3.7 cm

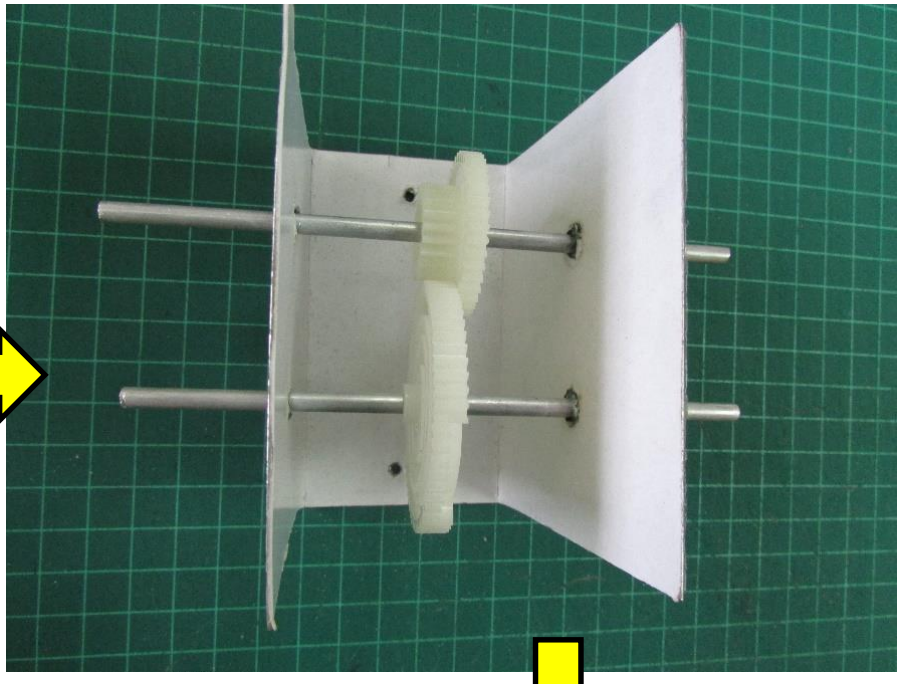


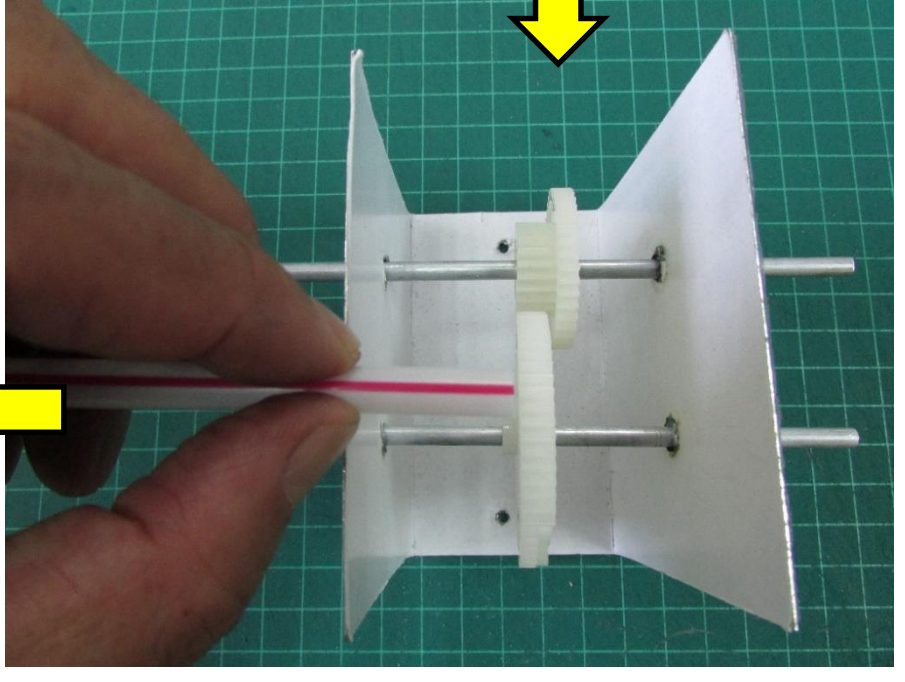


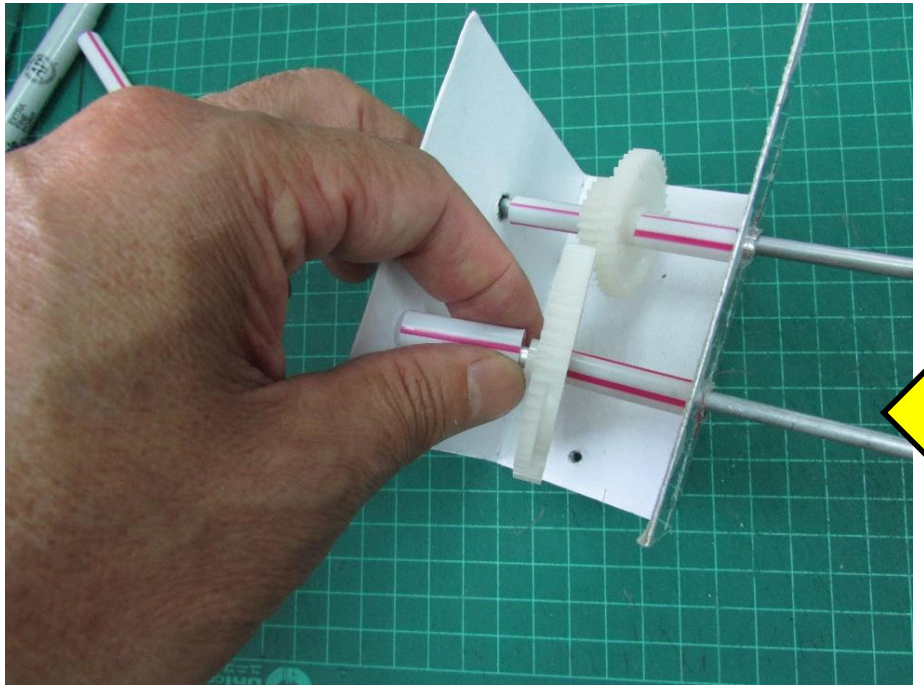


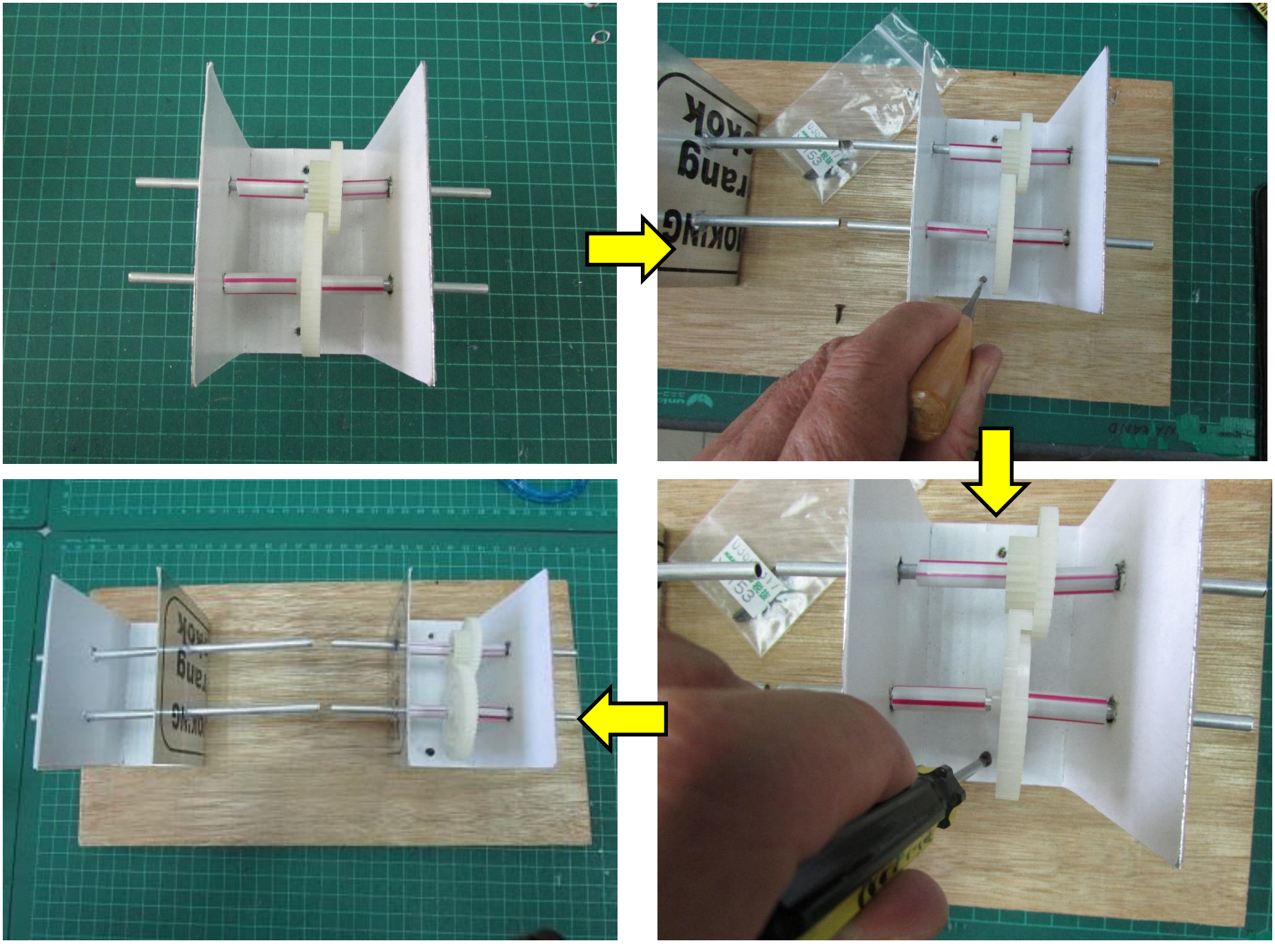

3.7 cm
3.2~3.3cm


4.0 cm
3.7 cm
3.7 cm

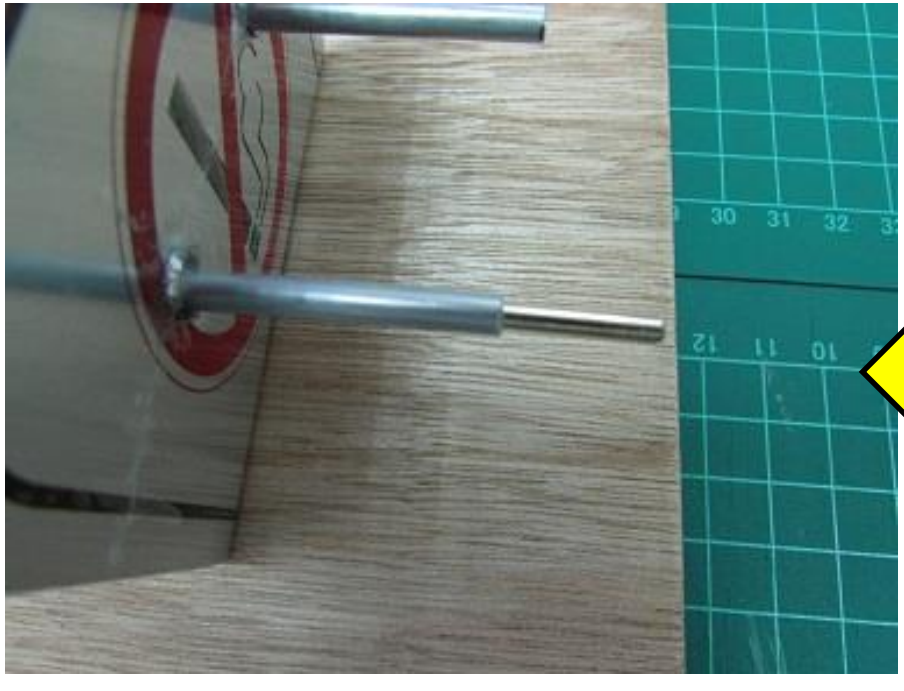









SUPER GLUE




Thank you for listening!

TOPIC 2 : Solar Cells

Scientific Process

How can we produce electricity?

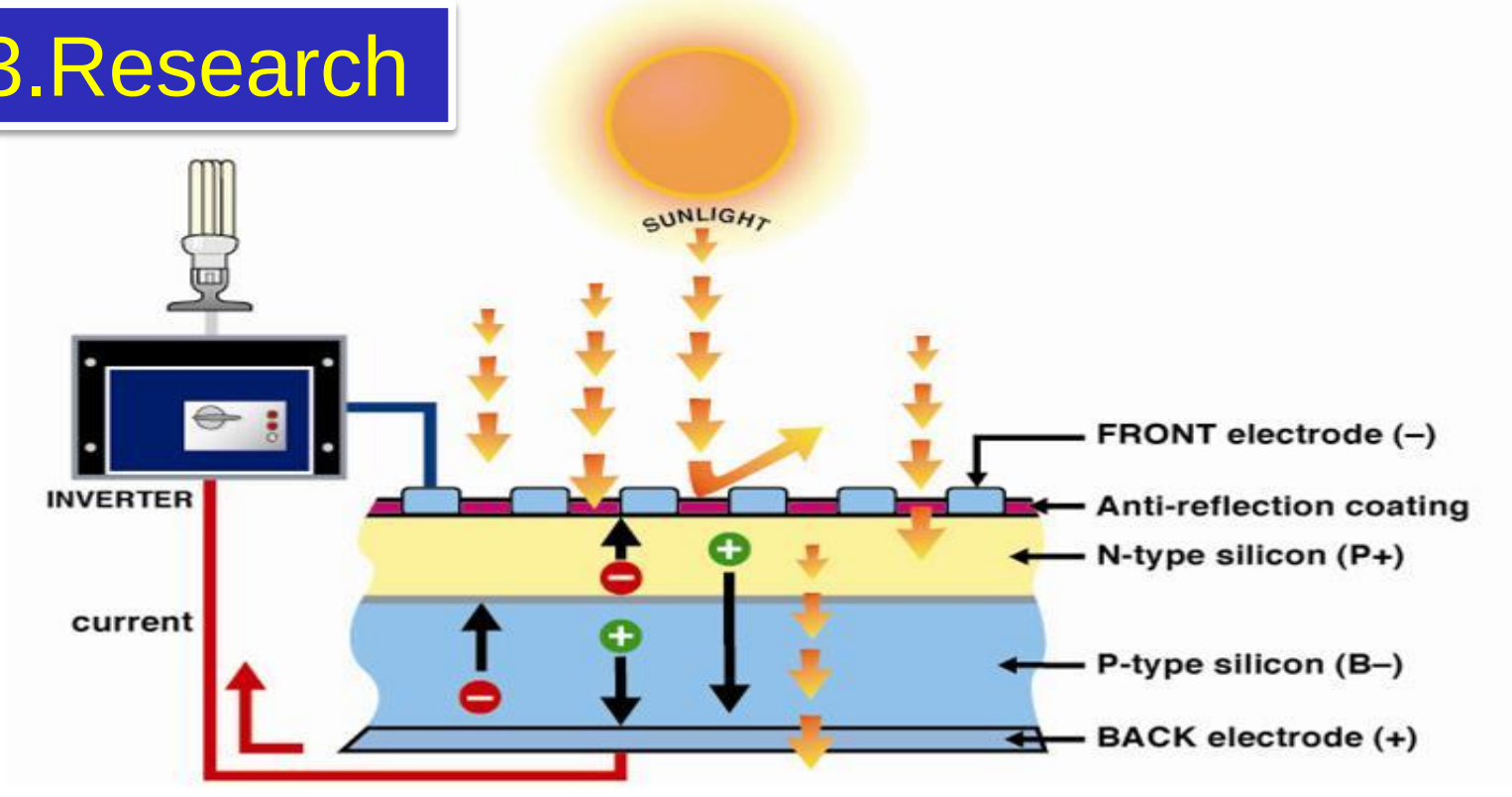
1. Ask

To find the another way to produce electricity !

2.Purpose

Solar Cells

3.Research

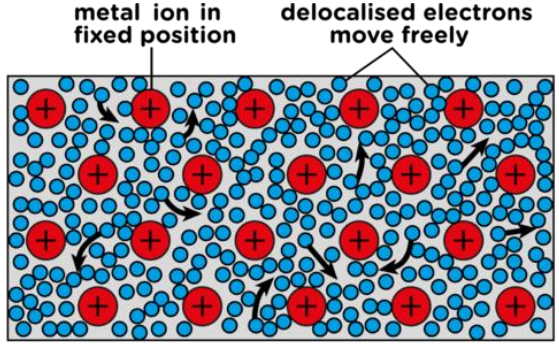


Pre Inquiry-Based Learning

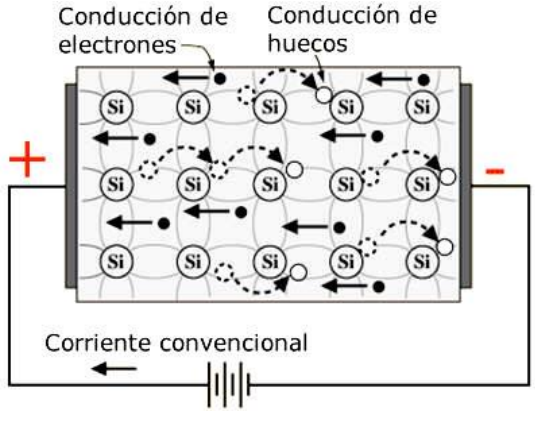
Q1. In which materials can electricity flow ?

Materials

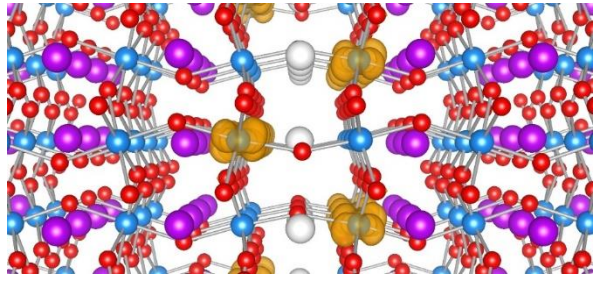
- Conductor



- Semi-Conductor

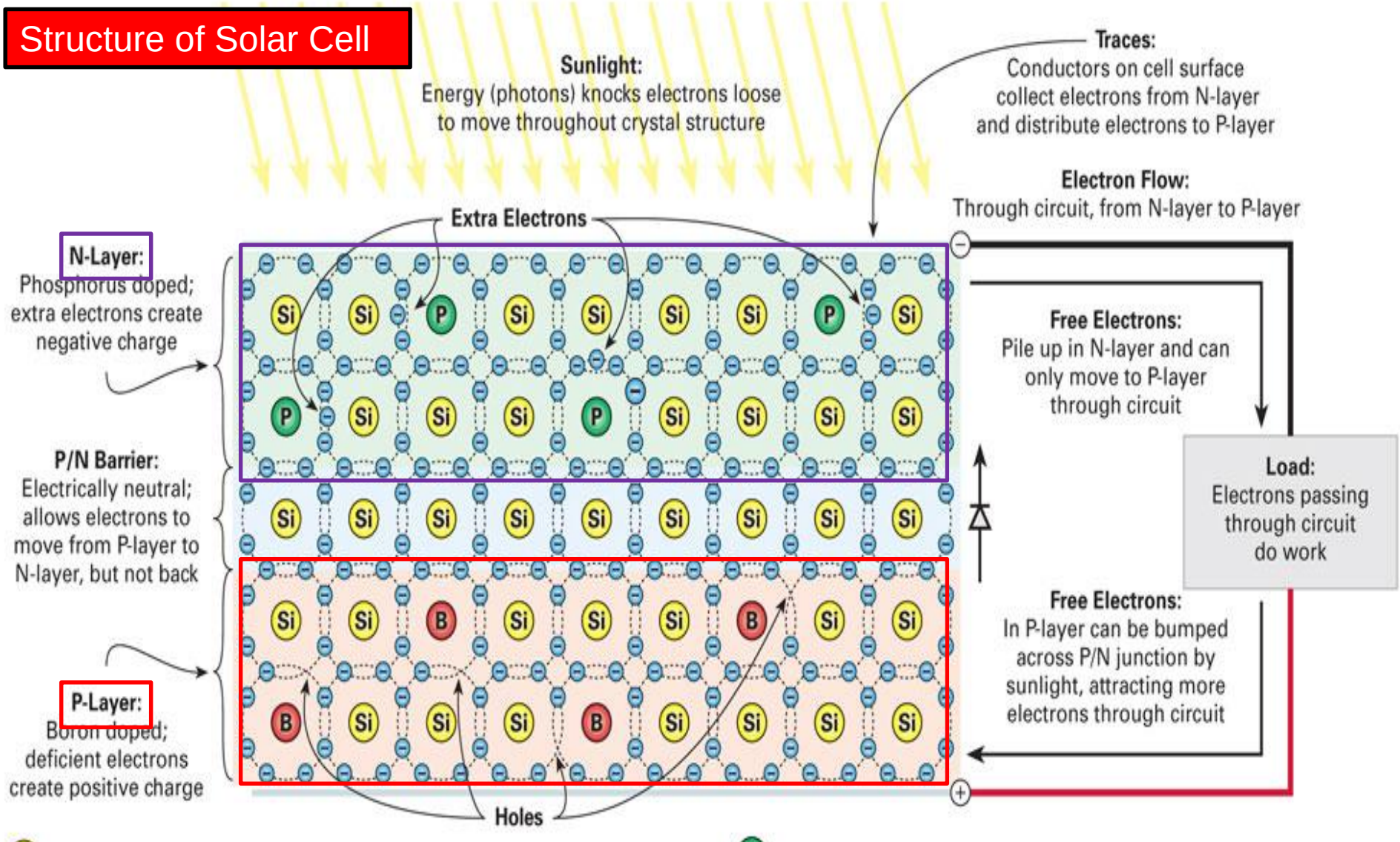


- Insulator



P/N Silicon and the Function of a PV Cell

Structure of Solar Cell

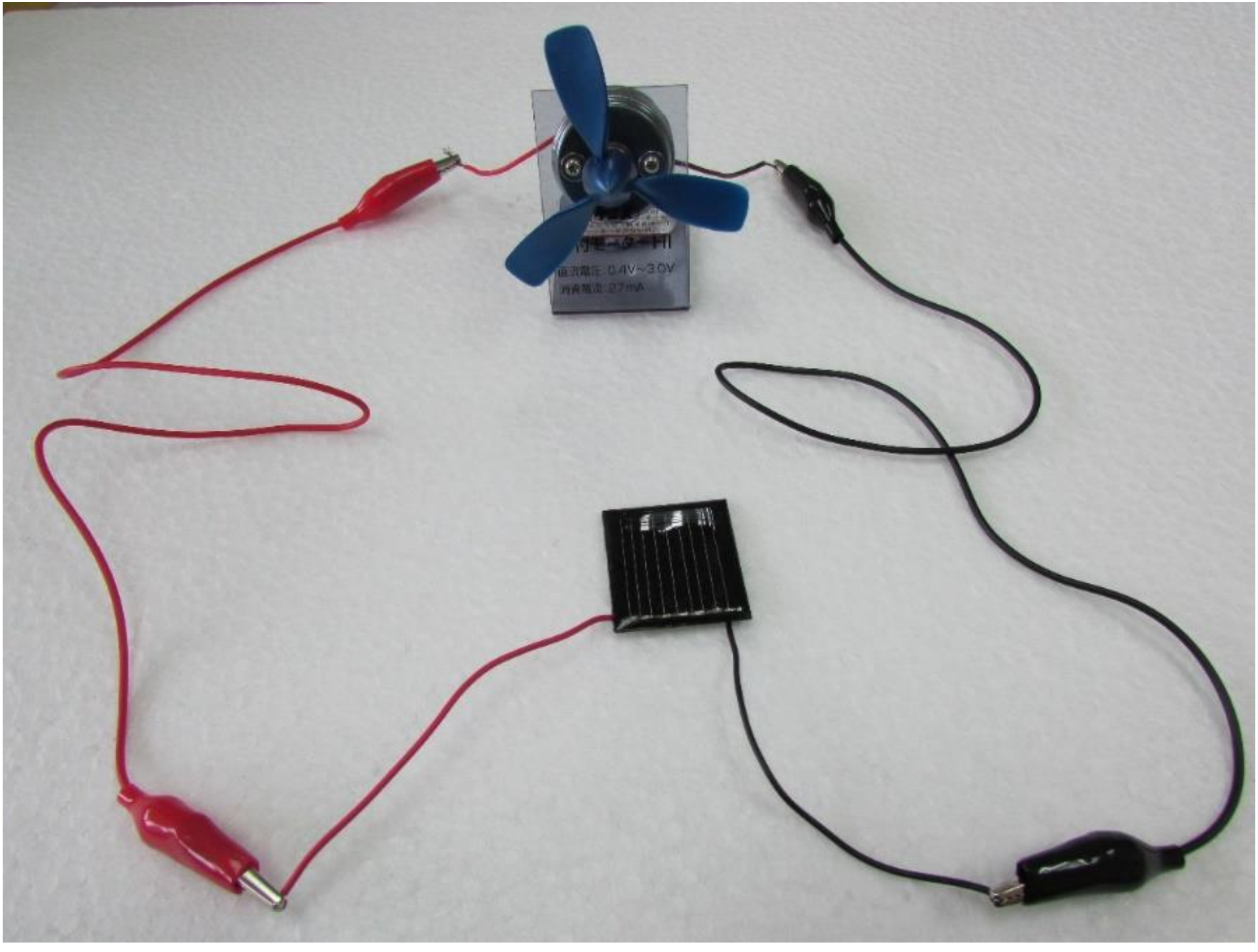


Si **Silicon Atom:** 4 electrons in outer shell. Shares with other silicon atoms to form a stable crystal bond of 8 electrons.

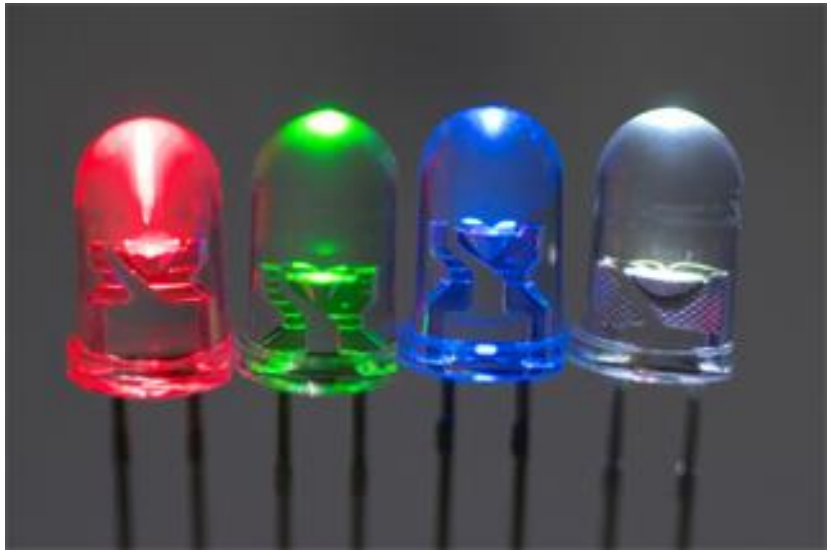
P **Phosphorus Atom:** 5 electrons in outer shell. Shares with silicon atoms to form a crystal bond of 8, plus one extra electron.

B **Boron Atom:** 3 electrons in outer shell. Shares with silicon atoms to form a crystal bond of 7 electrons and 1 hole, readily attracting extra electrons.

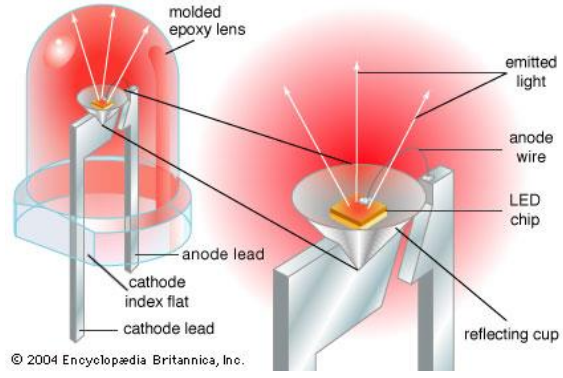
Electron: Knocked around by energy of sunlight; moves through circuit from N-layer to P-layer.



LED(Light Emitting Diode)

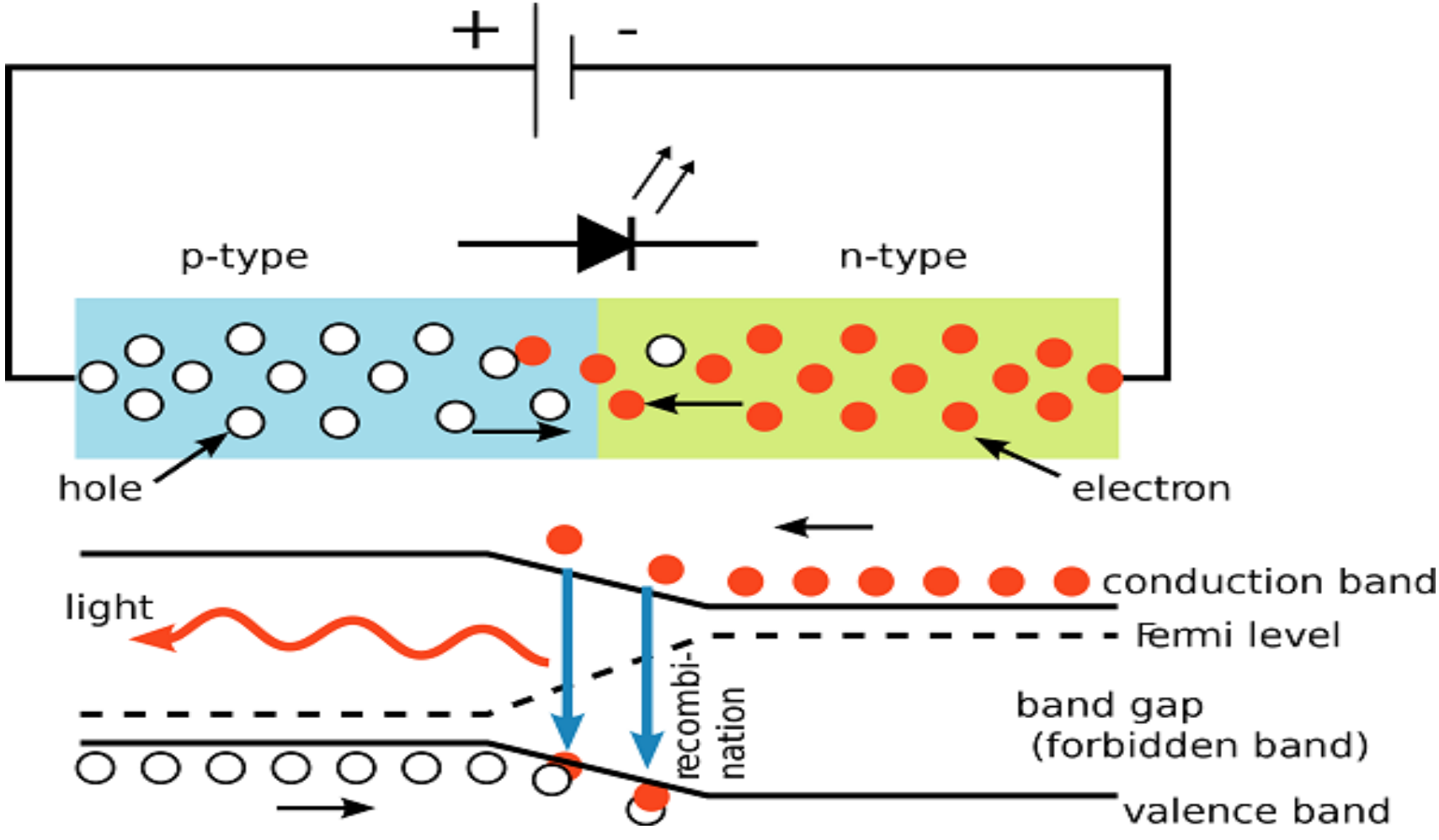


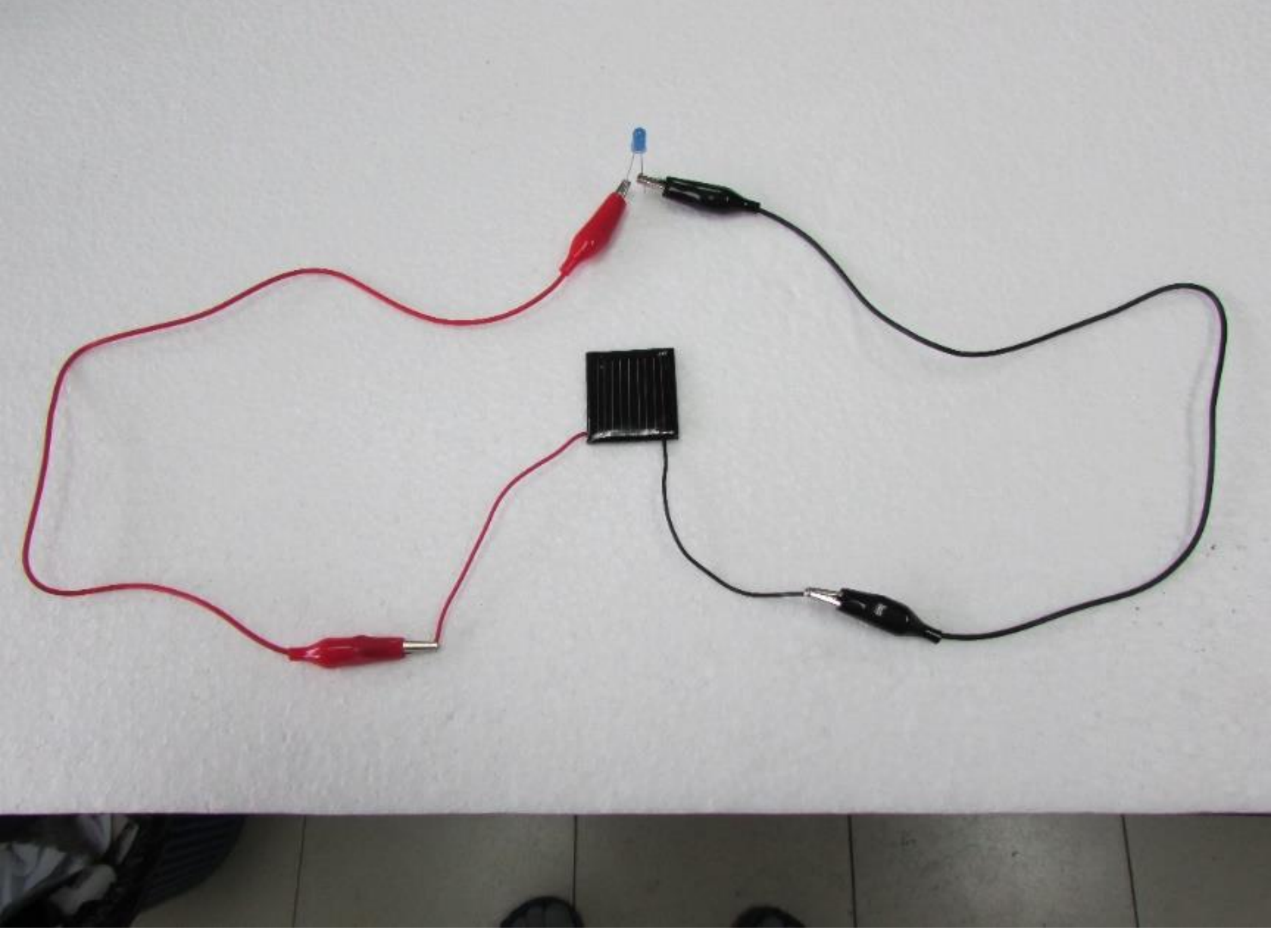
Structure of LED



Benefits of LED

1) Saving Energy
2) Long life
3) Low price



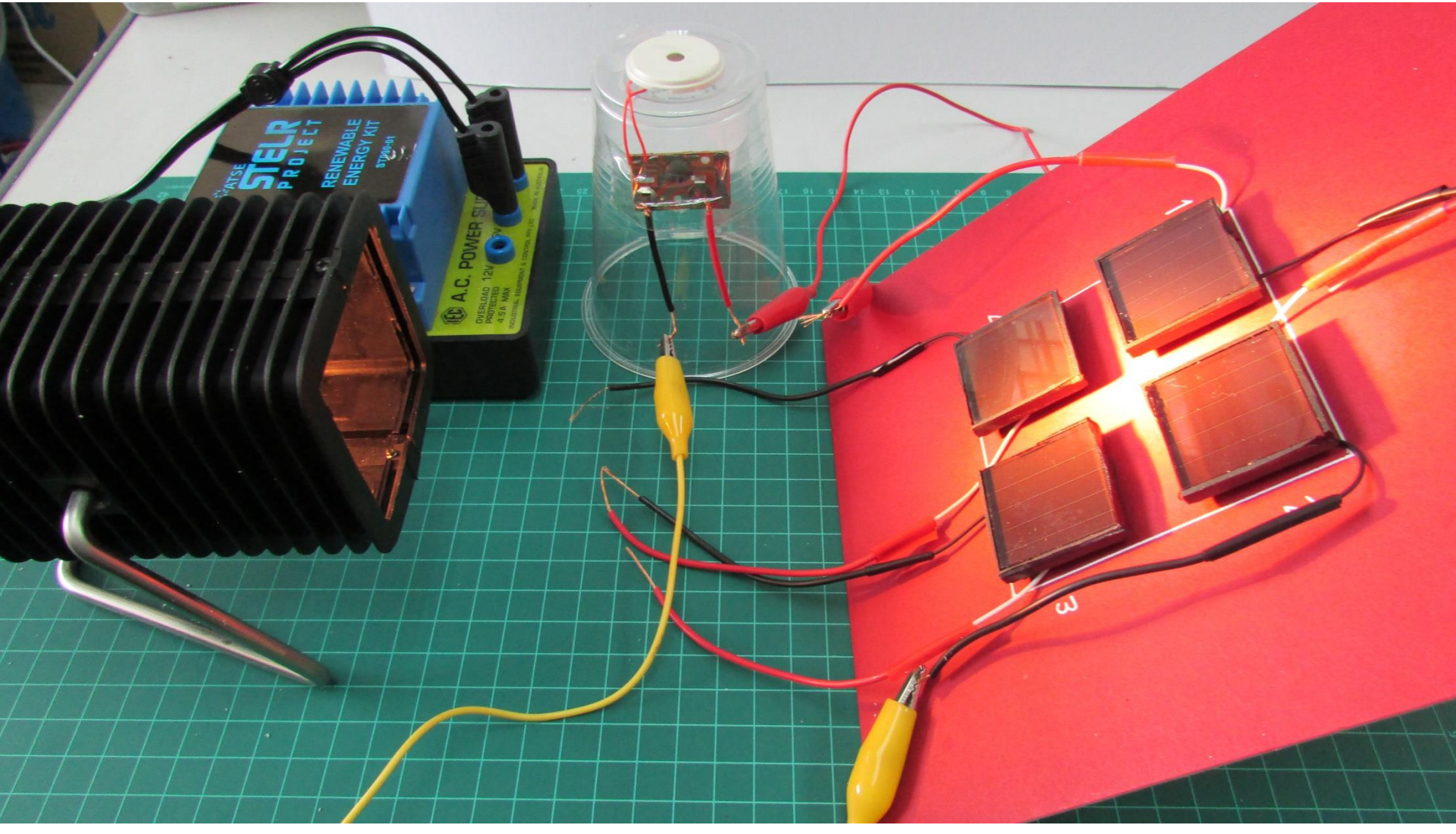


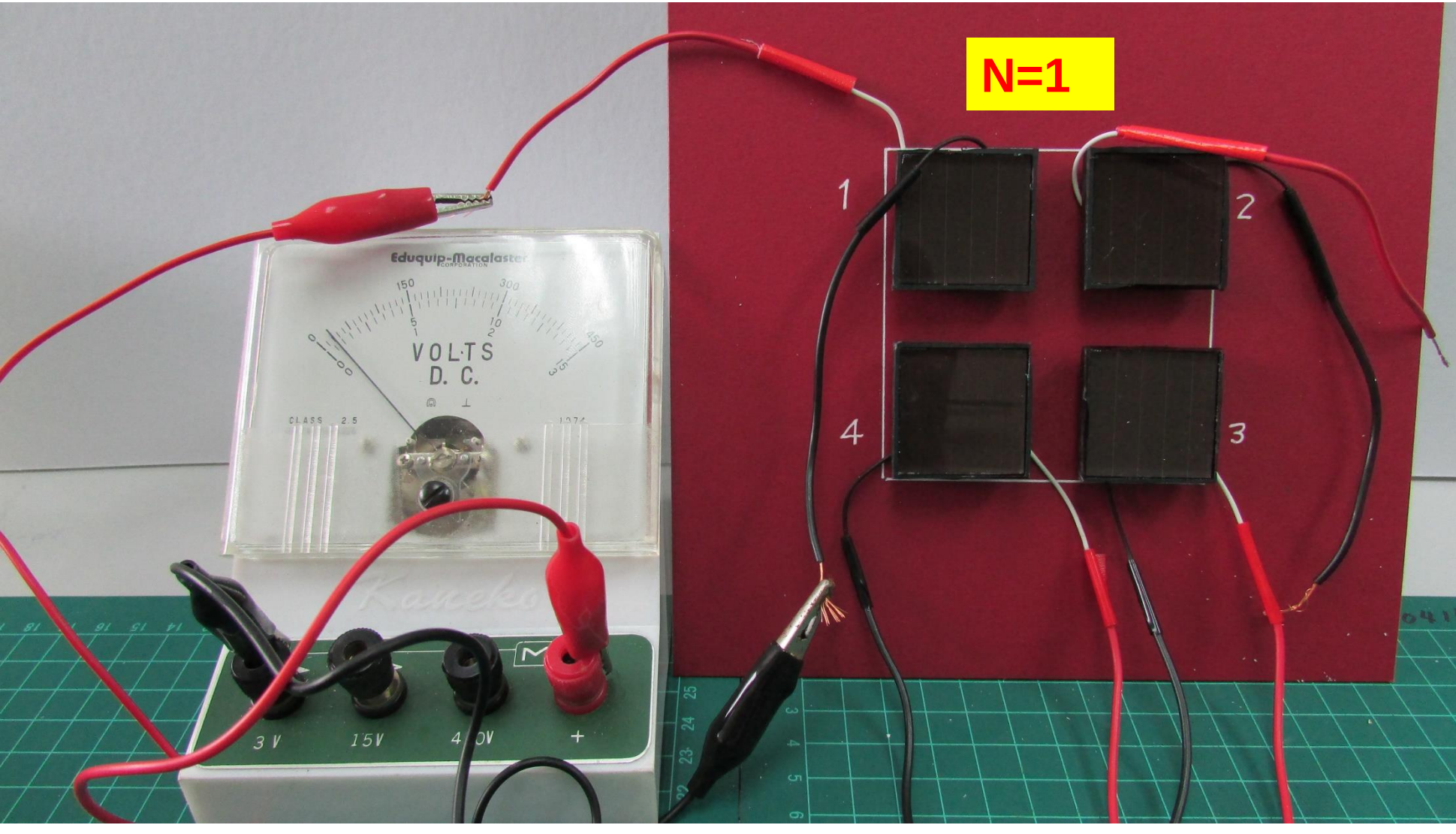
4. Hypothesis

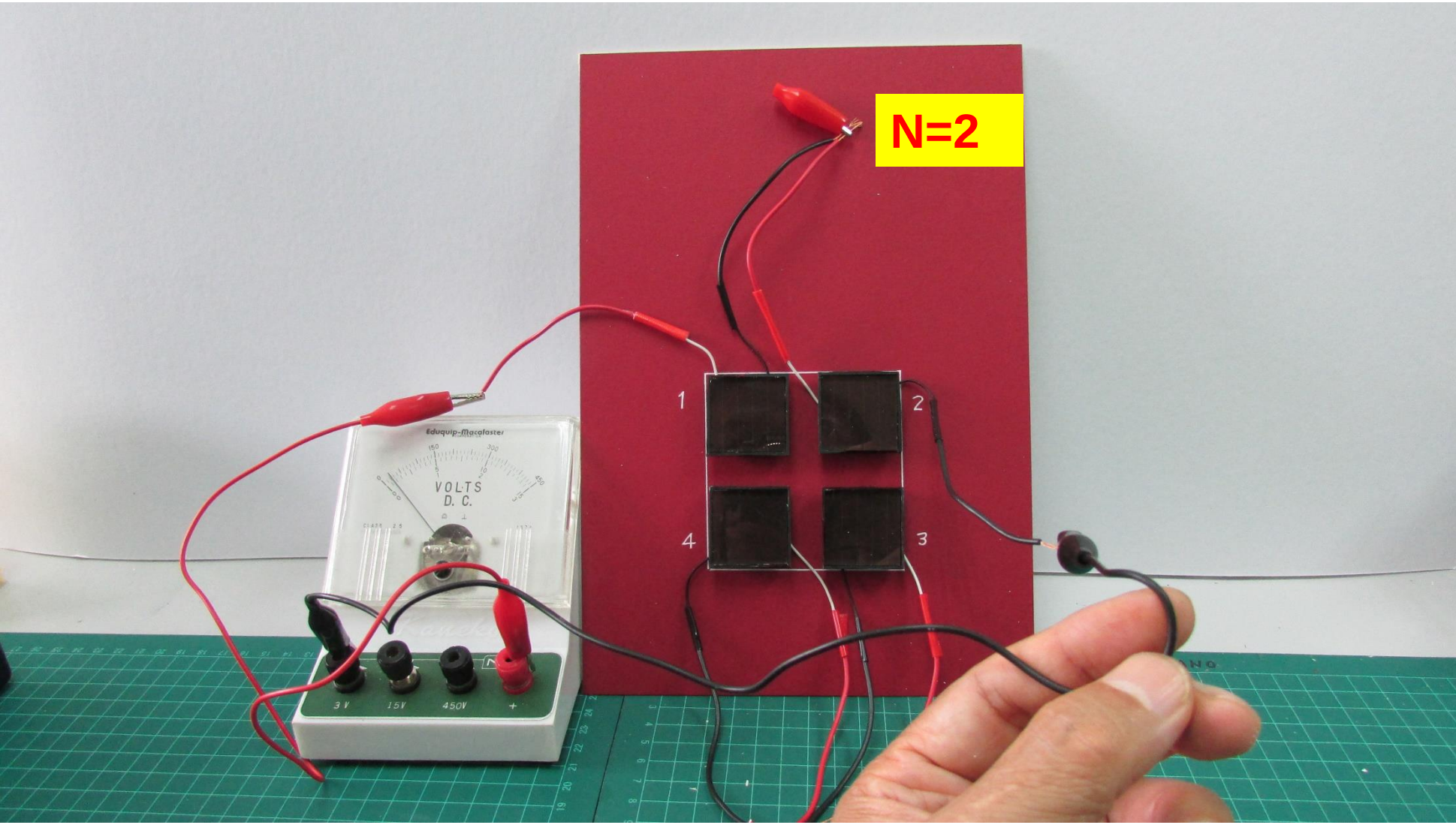
To find the best way in which electricity can be produced as much as possible!

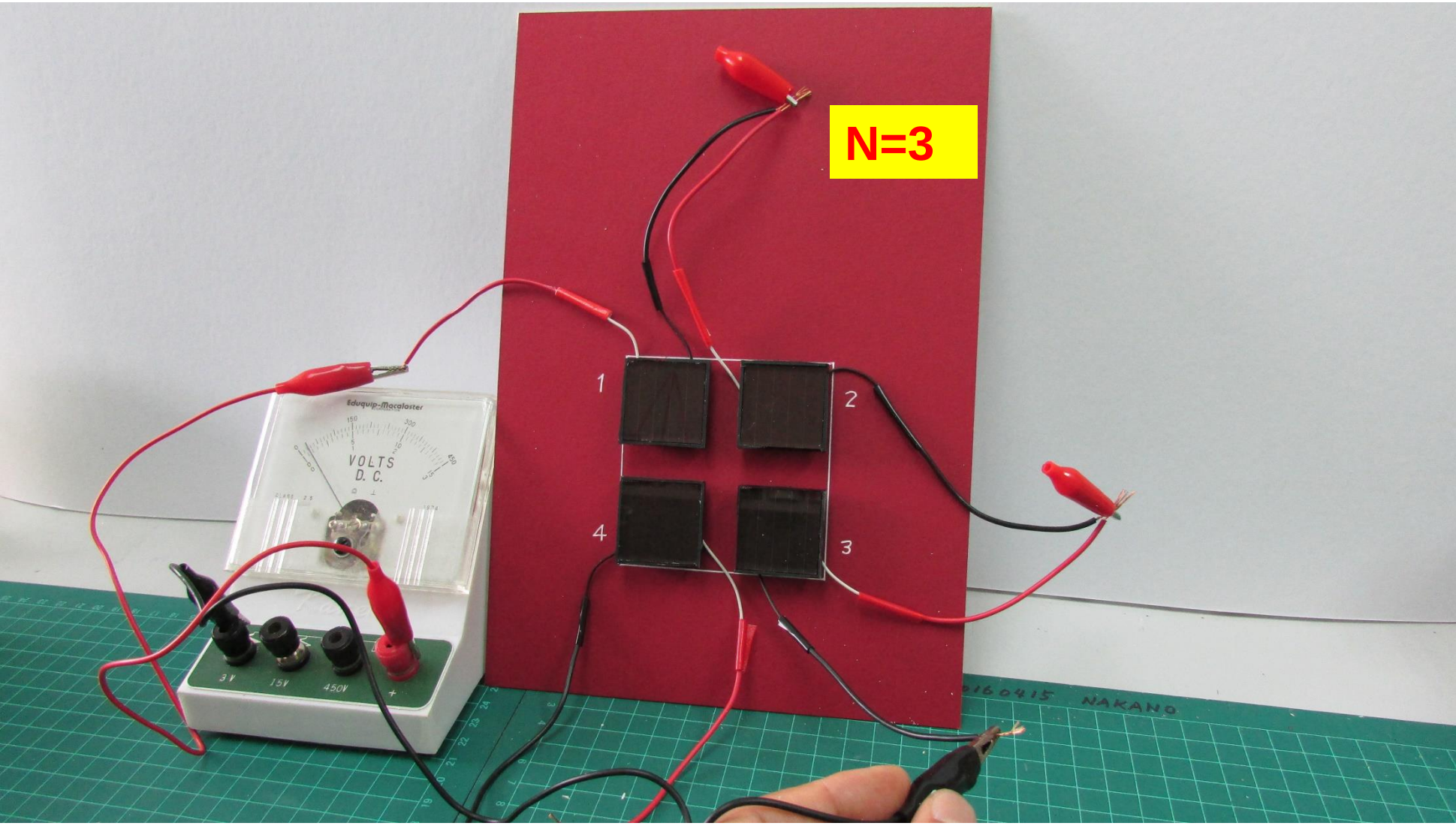
Idea 1	Series connection is better?
Idea 2	Larger angle against light is better?
Idea 3	Shorter distance is better?

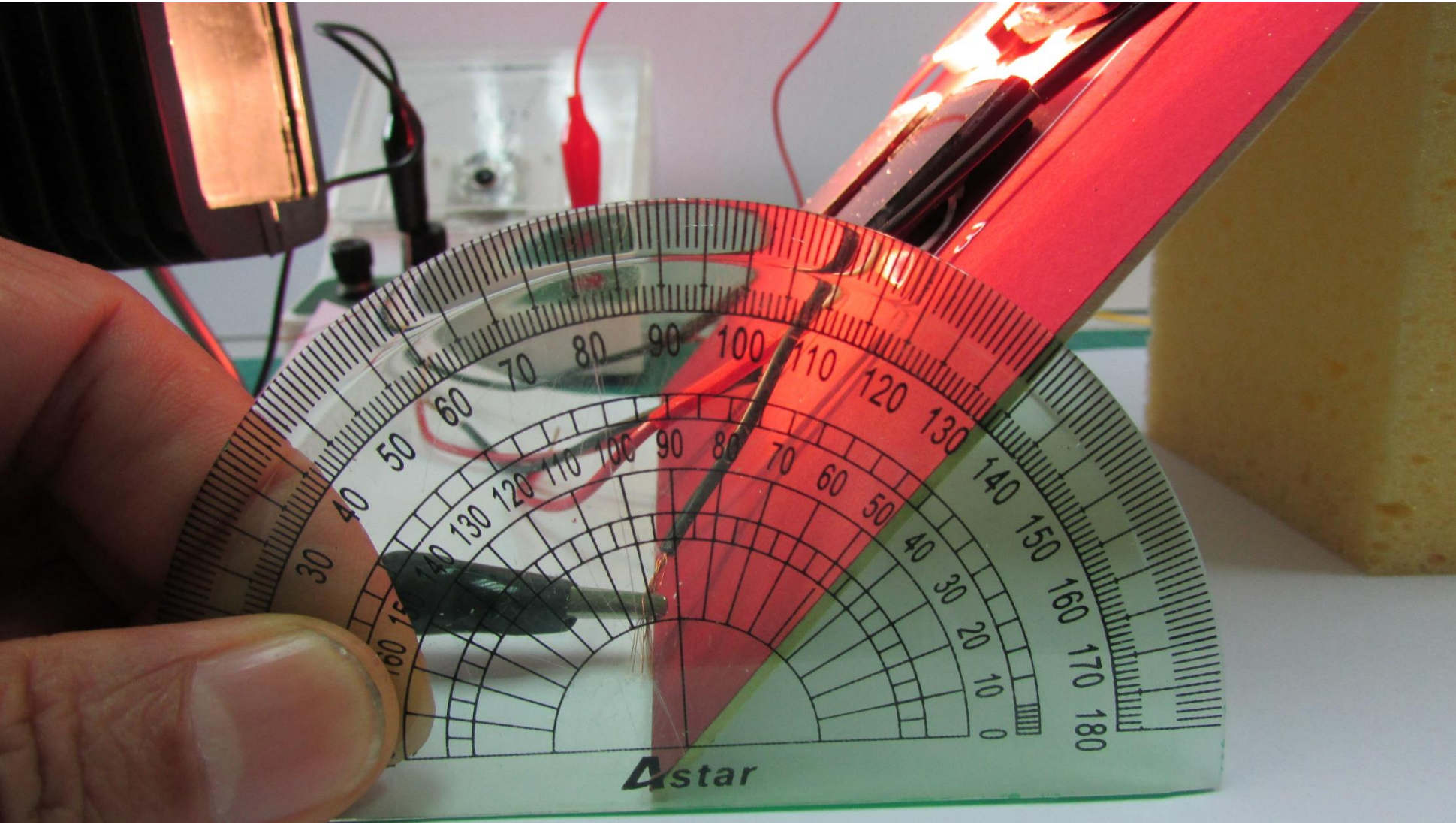
Experiment & Gather data

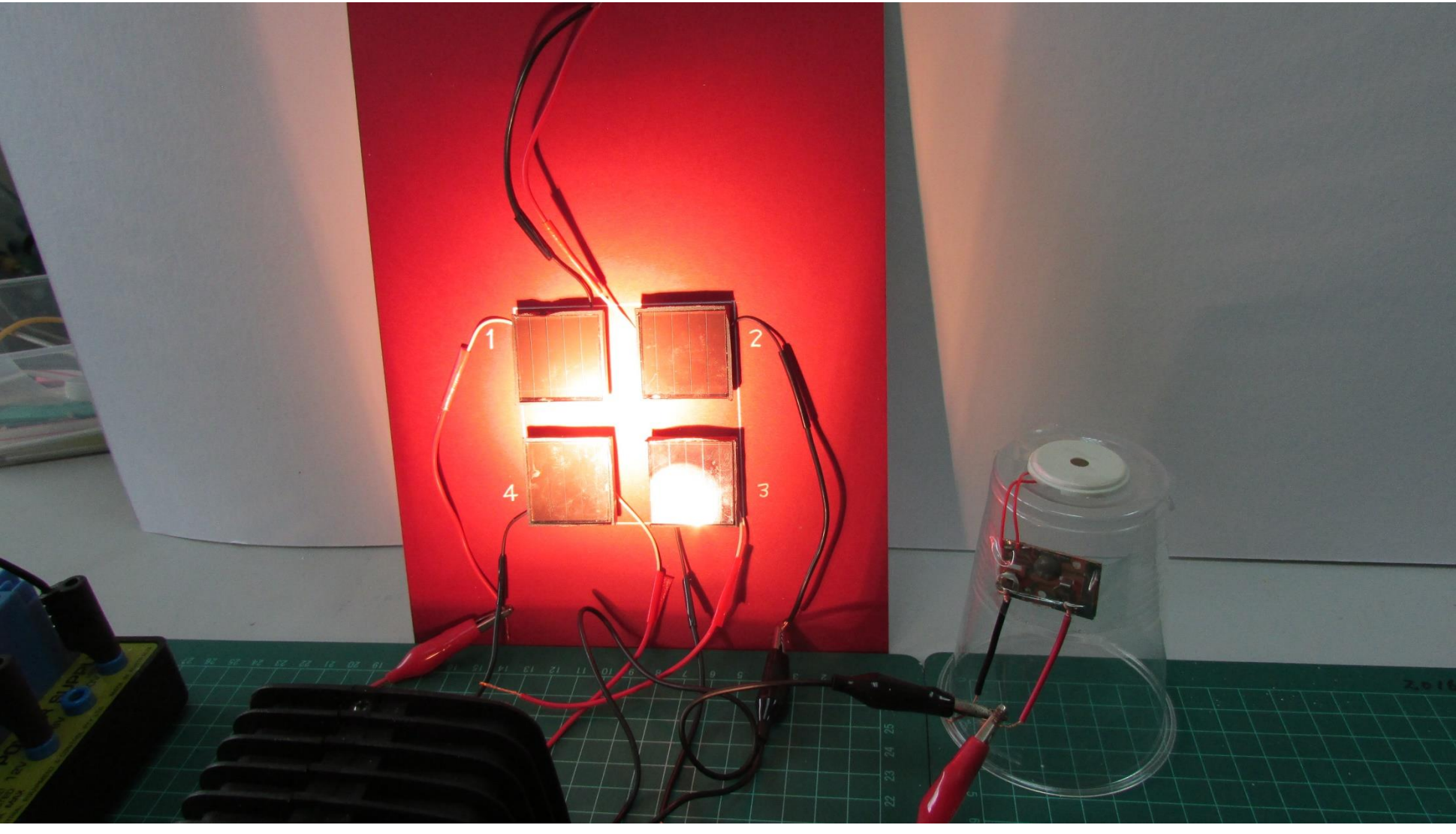


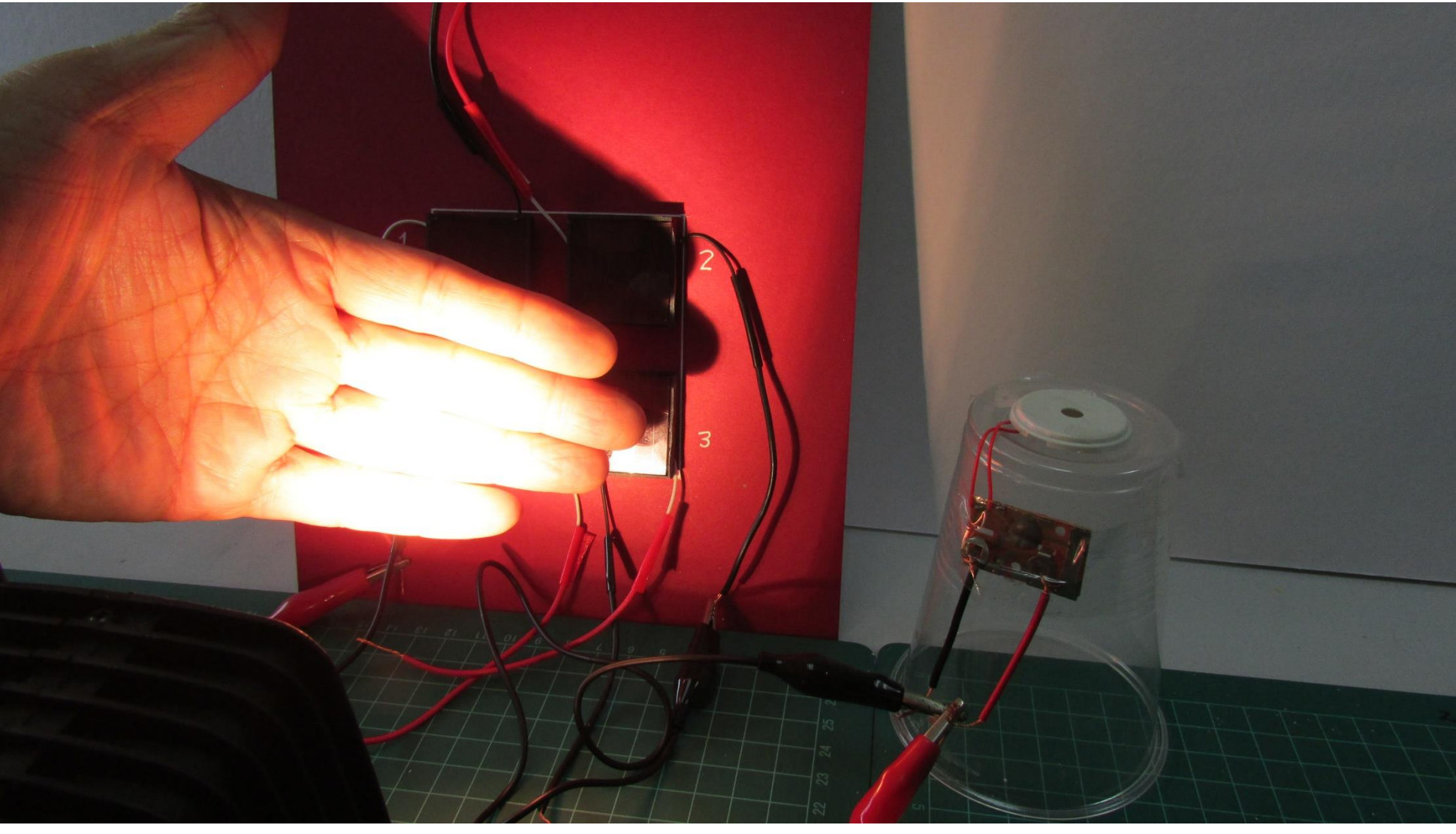

N=1
1
2
3
4
Eduquip-Macalaster
VOLTS
D. C.
CLASS 2.5
3 V
15V
+

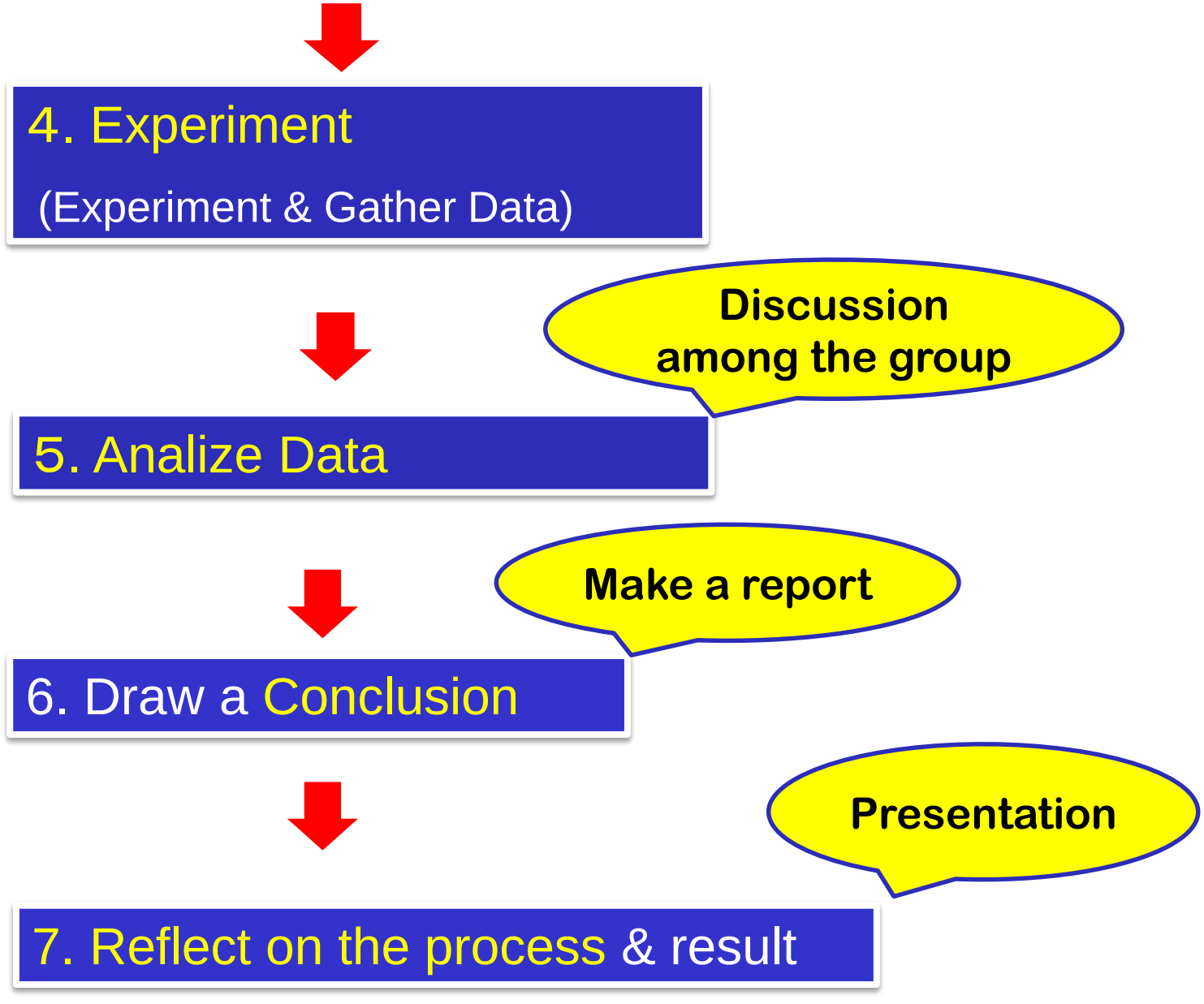

N=2
1
2
3
4
Eduquip-Macafaster
VOLTS
D. C.
3 V
15V
450V
+


N=3
1
2
3
4
VOLTS
D. C.
Eduquip-Macalaster
3 V
15V
450V
+
20160415 NAKANO


Astar


1
2
3
4

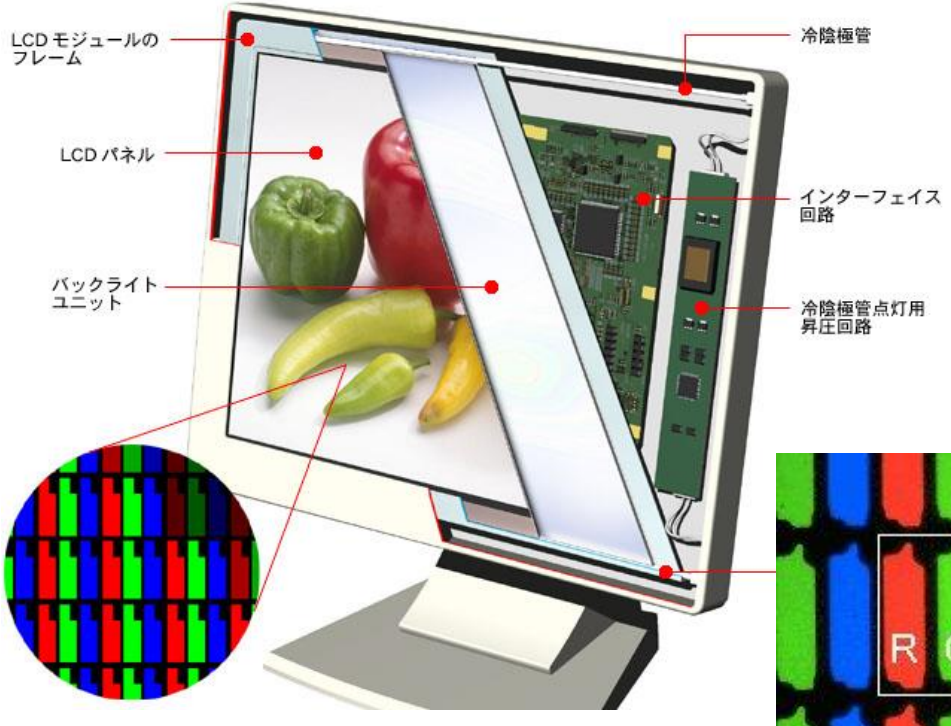

2
3

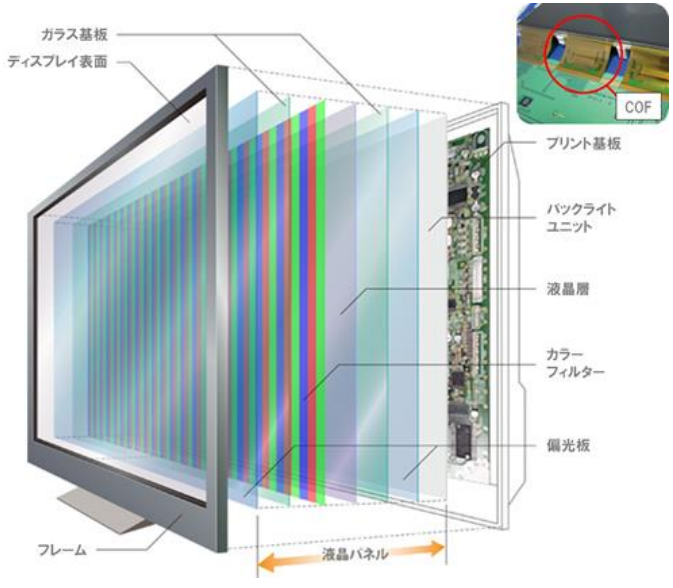

4. Experiment
(Experiment & Gather Data)
Discussion among the group
5. Analize Data
Make a report
6. Draw a Conclusion
Presentation
7. Reflect on the process & result

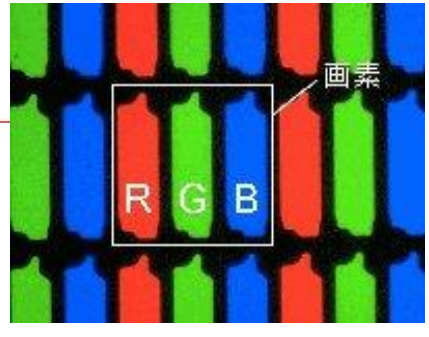
Presentation Time!

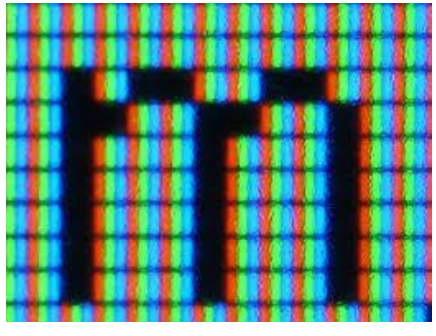
Present the results of your group based on DATA

Composition of light



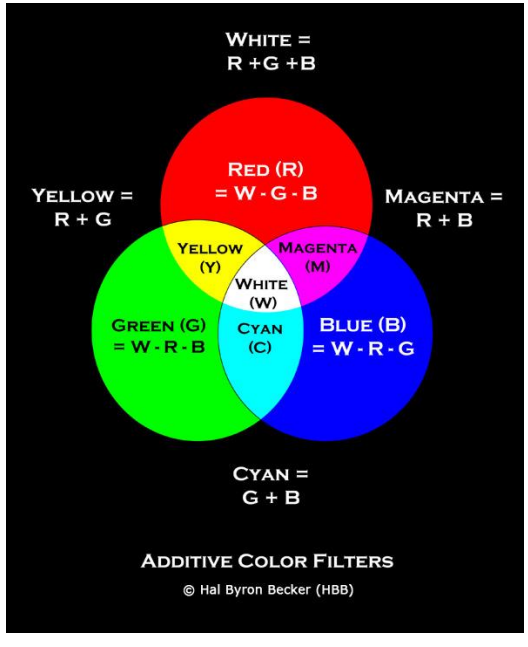






Additional Information

Composition of light

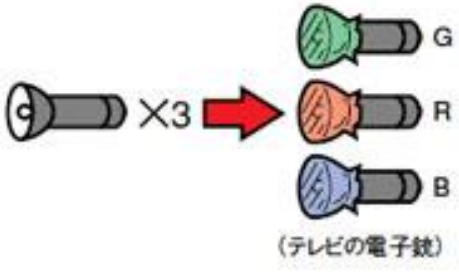


Three primary colours of light

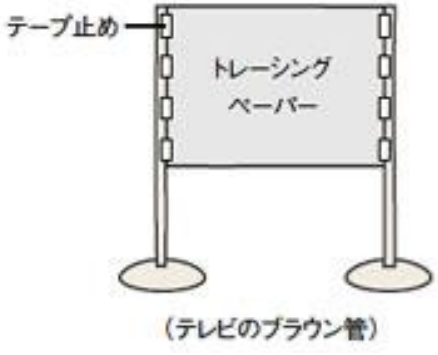
Activity 3

Let’s make your own colours !

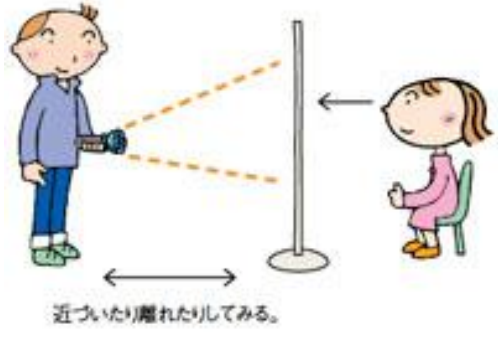
STEP 1

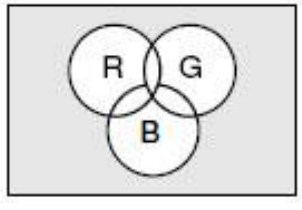


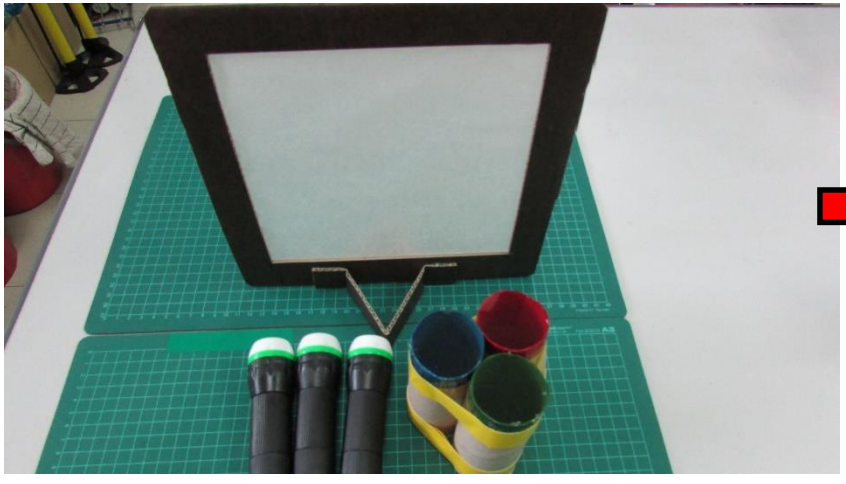
STEP 2

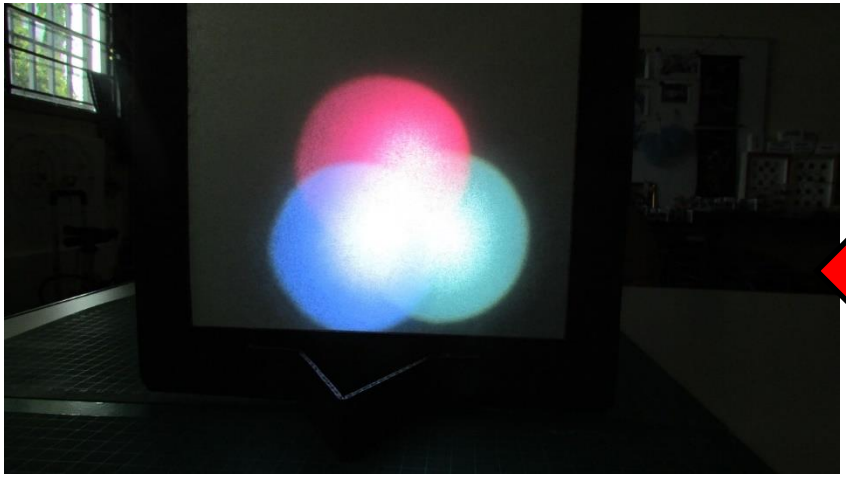


STEP 3










Thank you for listening!