Solar Exploration

Before you start experimenting with the mini solar panels; close your eyes and face the sun. Slowly tilt your head up and down and turn around. What do you feel? Try to remember these feelings as you experiment with the mini solar panels - think of your face as a solar panel!

MATERIALS:

- 2 mini solar panels
- 1 motor (with a tape flag added to the pin)
- 2 wires with alligator clips on each end

TASK:

Using the materials you have been given, experiment with solar power! Record your findings using words, pictures or both. *Hint: sometimes the rotating pin on the motor gets stuck… give the flag a little "flick" to get it moving*

1. How can you make the motor run?

2. How can you make the motor run backwards?

3. What happens if you change the angle of the solar panel?

4. What happens if you shade some or all of the solar panel?

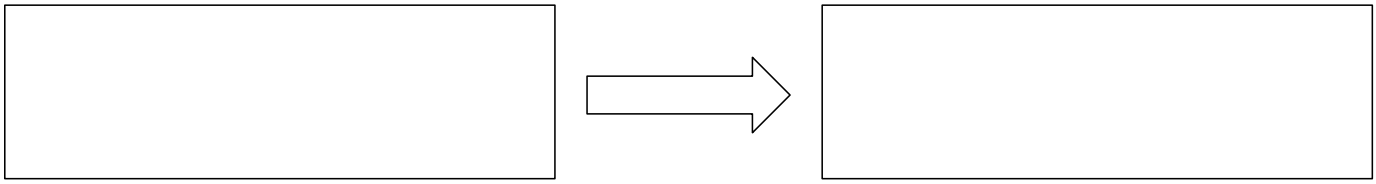
5. How can you make the motor run faster?

6. What happens if you shade <u>one</u> of the panels when BOTH are hooked up to the motor?

THINKING ABOUT VARIABLES 1:

Action we took….

Effect it had….



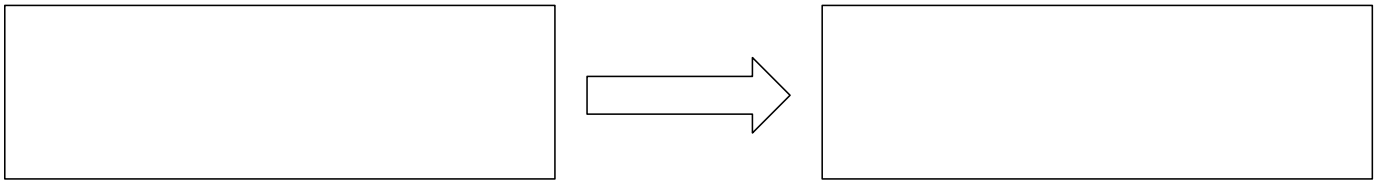
Independent variable that **we can change**….

Dependent variable that **we can measure**….

THINKING ABOUT VARIABLES 2:

Action we took….

Effect it had….

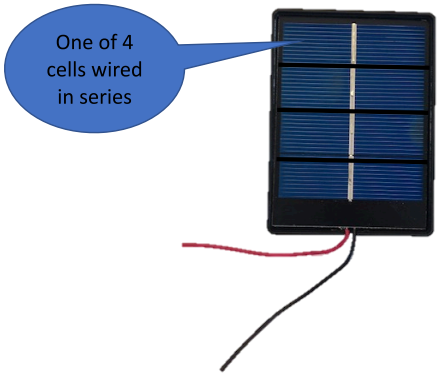


Independent variable that **we can change**….

Dependent variable that **we can measure**….

Exploring Photovoltaic (PV) Cells

Each mini solar panel is composed of four 0.5 volt solar cells wired in-series to create a 2-volt solar panel that can provide 0.2 Amps of current.



Power (Watts) = **Voltage** (Volts) **x Current** (Amps)

- **Current** = flow of electrons
- **Voltage** = electrical potential ("pressure" acting on the current)
- **Power** = doing work

Panels wired in Series (multiplies Volts)

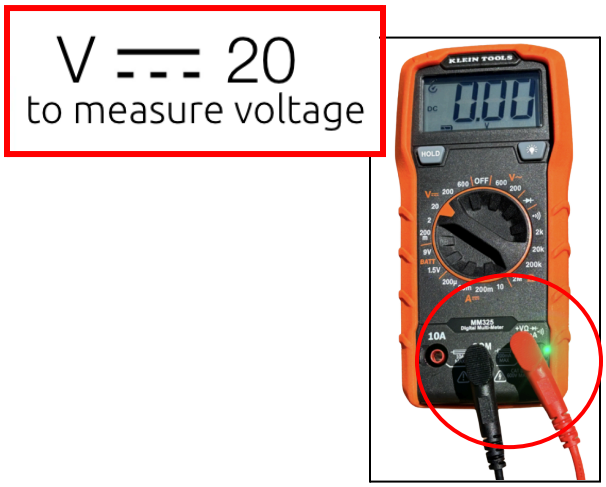
Panels wire in Parallel (multiplies Amps)

We will start by learning how to measure Voltage and Current using a Digital Multimeter (DMM).

Measuring Voltage

- Put the black test lead in the COM port on the meter and the red test lead in the V/Ω/mA port.
- **Set the digital multimeter (DMM) to 20 volts DC**.
- Connect the black meter lead to the negative (black) wire on the solar panel. Connect the red meter lead to the positive (red) wire on the solar panel.
- Aim the panel towards the sun and adjust the angle of the solar panel to the sun. Record the highest voltage reading you see.

Highest Voltage _____



- Now shade the Panel and record the voltage.

Shaded Panel Voltage _____

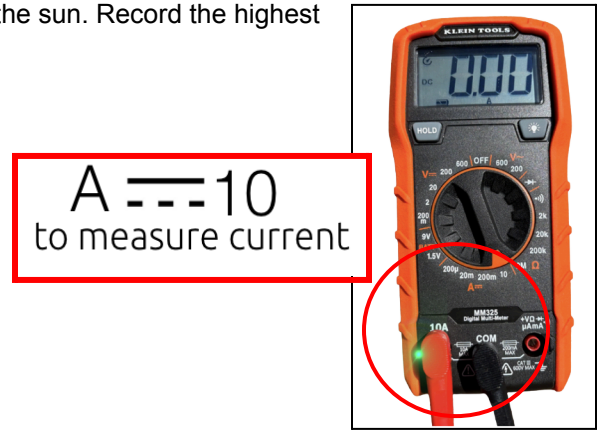
Measuring Current (Amps)

- Set the digital multimeter (DMM) to test amps DC: *Keep the black test lead in the COM port on the meter and plug the red test lead into the 10A DC port.*
- **Set the digital multimeter (DMM) to 10 amps DC**.
- Connect the black meter lead to the negative (black) wire on the Solar panel.
- Connect the red meter lead to the positive (red) wire on the Solar panel.
- Aim the panel towards the sun and adjust the angle of the panel to the sun. Record the highest amperage reading.

Highest Amps _____

- Now shade the Panel and record the amperage.

Shaded Panel Amps _____



Using Solar Energy to do Work!

- Connect the wires from the solar panel to the tabs on the bottom of the DC motor. *Be gentle, the tabs are fairly thin.* Then aim the solar panel toward the sun… what happens? *Hint: sometimes the rotating pin on the motor gets stuck… give the flag a little "flick" to get it moving.*

- Shade the panel… what happens?

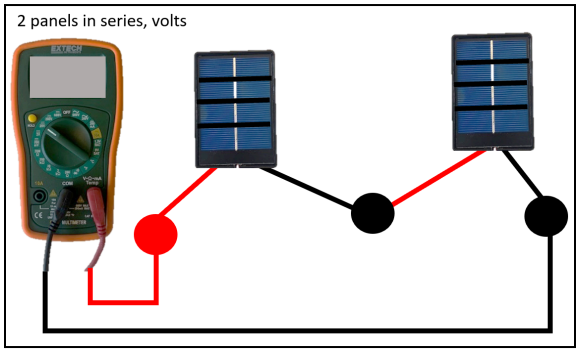
- Switch the wire-to-tab connections and aim the panel towards the sun… what changes in regards to the motor?

    - How does this reinforce that solar panels produce ***Direct Current (DC)*** electricity?

Now we are going to add a second solar panel, in two different ways, to see how ***Voltage****,* ***Current*** *and* ***Power*** *are affected!*

Wiring in Series

Quantitative Exploration:



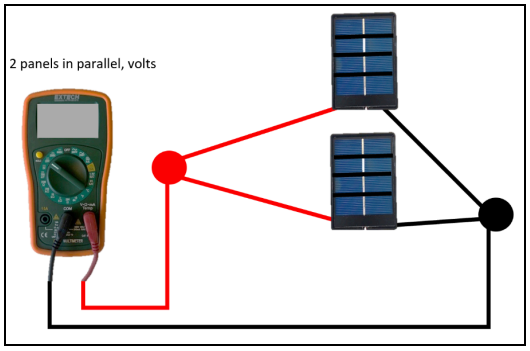
- Connect two panels together so that the red wire on one connects to the black wire of the other.
- Clip the two panels to the DMM as illustrated with the black wire attached to the black (COM) port and the red wire attached to either the red (V) port or the red (10A) port, based on what you are measuring:
    - Use the information on the previous page ("Measuring Voltage") to set up the DMM so you can collect the maximum Voltage of 2 mini panels in SERIES: _____
    - Use the information on the previous page ("Measuring Current") to set up the DMM so you can collect the maximum Amps of 2 mini panels in SERIES: _____
- How do these values compare to the values collected for 1 mini panel?

Qualitative Exploration:

- Disconnect the panels from the DMM and instead clip them to the tabs on the bottom of the DC motor. *Be gentle, the tabs are fairly thin.*
- Aim the solar panels toward the sun… what happens? Does the motor spin more? less? or the same as it did with **one** solar panel? (*If you can't remember, remove one of the panels to observe the difference.)*
- With BOTH panels, connected in series, to the motor, FULLY shade just ONE panel… what happens?

Wiring in Parallel

Quantitative Exploration:



- Connect two panels together by connecting their red wires to each other and their black wires to each other.
- Clip the two panels to the DMM as illustrated with the black wires attached to the black (COM) port and the red wires attached to either the red (V) port or the red (10A) port, based on what you are measuring:
    - Use the information on the previous page ("Measuring Voltage") to set up the DMM so you can collect the maximum Voltage of 2 mini panels in PARALLEL: _____
    - Use the information on the previous page ("Measuring Current") to set up the DMM so you can collect the maximum Amps of 2 mini panels in PARALLEL: _____
- How do these values compare to the values collected for 1 mini panel?

Qualitative Exploration:

- Disconnect the panels from the DMM and instead clip them to the tabs on the bottom of the DC motor. *Be gentle, the tabs are fairly thin.*
- Aim the solar panels toward the sun… what happens? Does the motor spin more? less? or the same as it did with **one** solar panel? (*If you can't remember, remove one of the panels to observe the difference.)*
- With BOTH panels, connected in series, to the motor, FULLY shade just ONE panel… what happens?

The panels in a solar array - aka a solar field - are always wired to each other in parallel (not in series). Give one reason why based on your **quantitative data** and one reason based on your **qualitative data** from this activity.