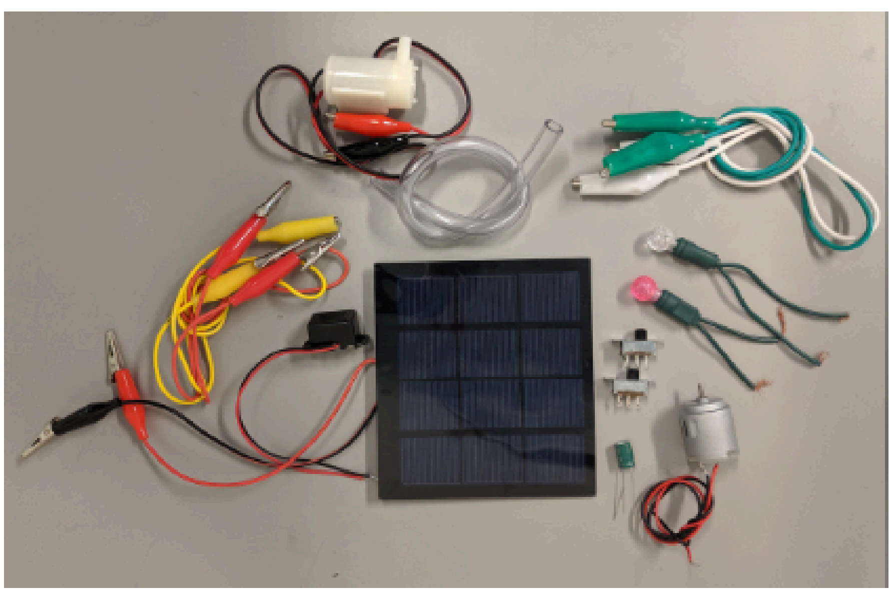
Educator Kit: Solar Energy
Materials List

10 student kits
1 multimeter
2 solar panels
1 switch
1 motor
1 buzzer
1 set of alligator clips
2 LED lights

1 wire stripper

3 books
Our Planet
Catch the Sun
Everyday Superheroes

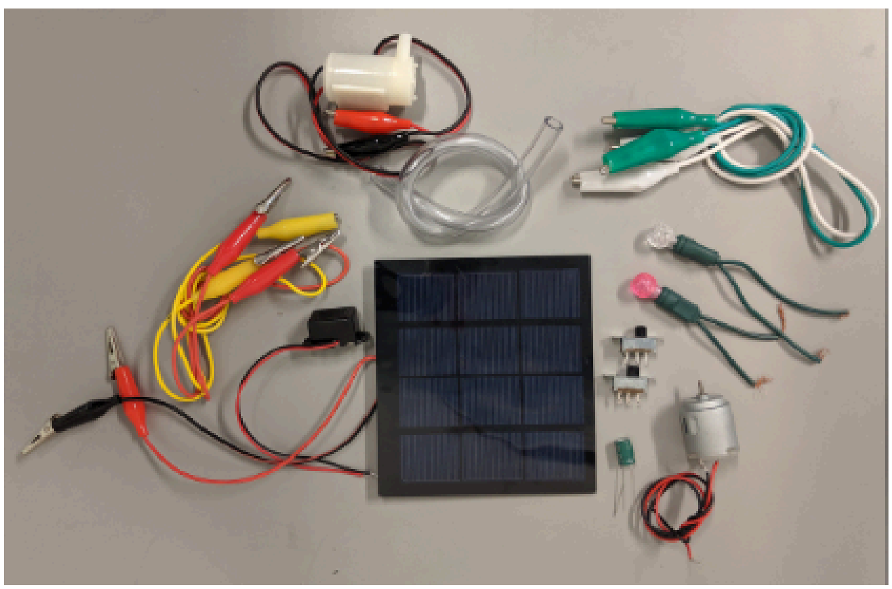


Solar Energy Classroom Kit (Teacher Resource)

Ages: grade 4 & up

Transform solar energy into electricity!
The intensity, angle, and amount of light energy can be modified to produce different amounts of electricity. Students will enjoy experimenting with different equipment to explore generating electricity.

Classroom Kit includes: adequate supplies for small group experimentation of circuits utilizing solar panels to generate electricity to power motors, buzzers, and LED bulbs



Donated by the Center for the Advancement of Sustainable Energy

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Thank you for choosing this Resource Kit from the Center for the Advancement of Sustainable Energy.

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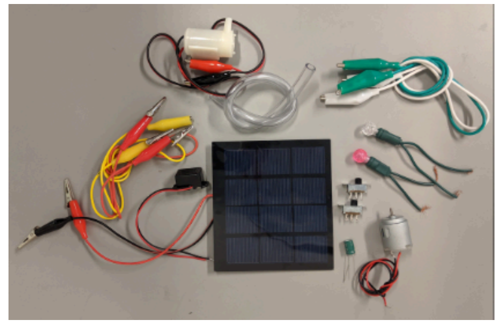

How to use kit materials

` https://www.youtube.com/watch?v=67IBTUZF3_k

TedEd: How solar panels work?

https://www.youtube.com/watch?v=xKxrkht7CpY&t=193s

KidWind Renewable Energy Challenge

https://www.youtube.com/watch?v=n9rR9NH8l1Y

Contact Information

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Solar Energy
TEACHER

We get most of our energy from the sun. We call it **solar energy**. It travels from the sun to the Earth in waves or rays. Some are light rays that we can see. Some rays we cannot see, like x-rays. The sun is a star. It is a giant ball of gas. It sends out huge amounts of energy every day. Most of the energy goes off into space. Only a small part reaches the Earth.

We use solar energy in many ways. All day, we use sunlight to see what we're doing and where we're going. Sunlight turns into heat when it hits things. Without the sun, we couldn't live on the Earth—it would be too cold. We use the sun's energy to heat water and dry clothes.

Plants use the light from the sun to grow. Plants take the energy in light and store it in their roots, stems, fruits, and leaves. That energy feeds every living thing on Earth. We can also burn plants to make heat.

The energy from the sun makes rain fall and the wind blow. We can capture that energy with dams and windmills. Coal, oil, and natural gas were made from prehistoric plants and animals. The energy in them came from the sun. We use that energy to cook our food, warm our houses, run our cars, and make electricity.

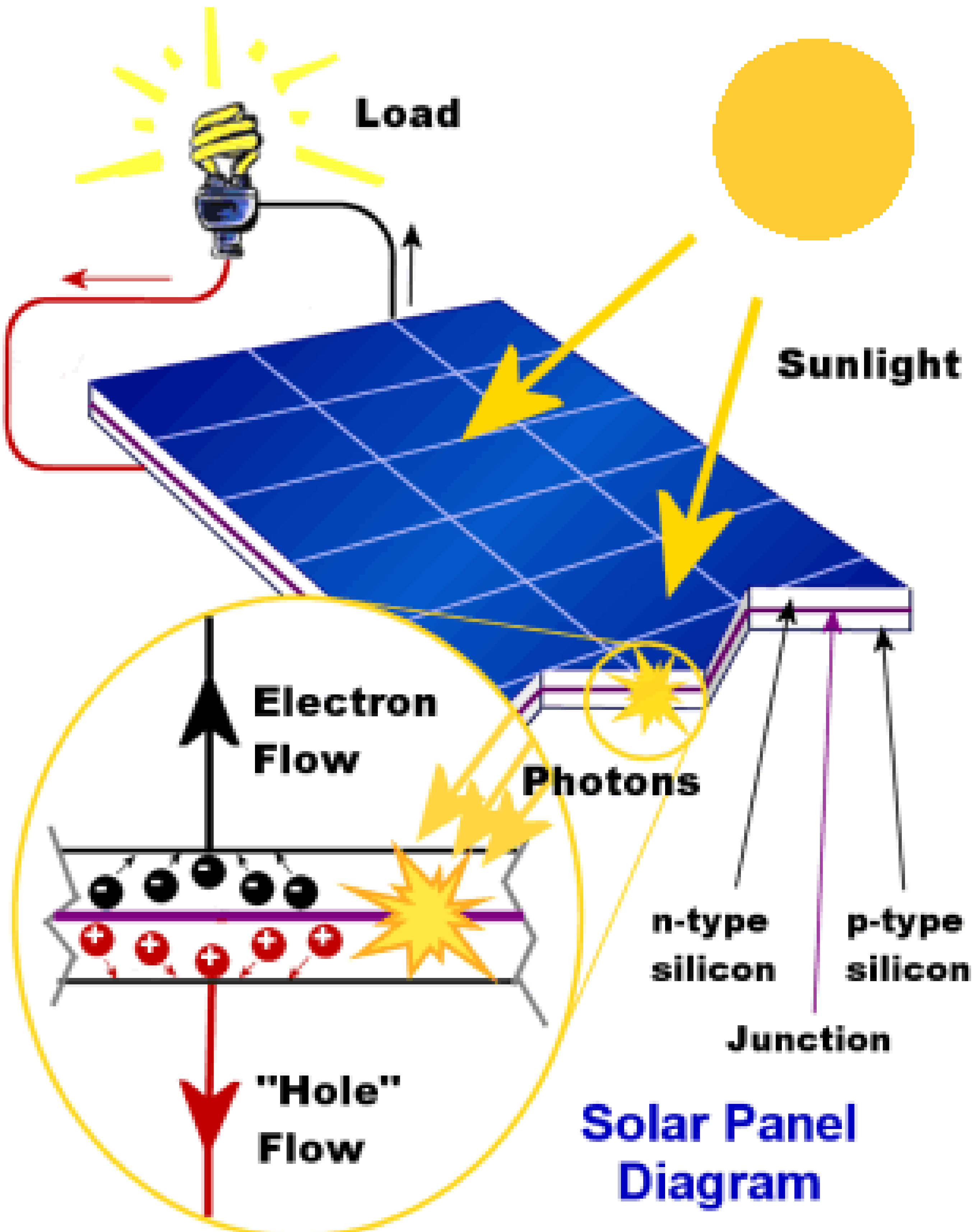
ENERGY CHANT

SOLAR ENERGY—
sun shine bright,
SOLAR ENERGY—
give me light!

Begin with arms over head in a big circle, swaying from side to side during "SOLAR ENERGY." Spread arms out wide during "sun shine bright." Repeat motions for second part of chant.

Solar energy is free and clean. There is enough for everyone, and we will never run out of it. Solar energy is **renewable**. The sun will keep making energy for millions of years. Why do we not use the sun for all our energy needs? We do not know how to yet. The hard part is capturing the sunlight. It shines all over the Earth, and only a little bit reaches any one place. On a cloudy day, most of the light never reaches the ground at all.

Lots of people put **solar collectors** on their roofs. Solar collectors capture the sunlight and turn it into heat. People heat their houses and their water using the sun's energy. **Solar cells** (solar panels) can turn light energy into electricity. Some toys and calculators use solar cells instead of batteries. Big solar cells can make enough electricity for a house. They can be expensive but good for houses far away from power lines. Today, solar energy provides a little more than 3 percent of the electricity we use, but it is growing each year as solar cells get used more. In the future, it could be a major source of energy. Scientists are looking for new ways to capture, store, and use solar energy more efficiently.

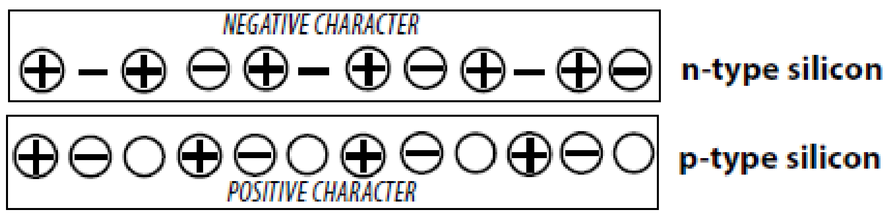


Source: https://www.circuitbasics.com/what-are-solar-panels/

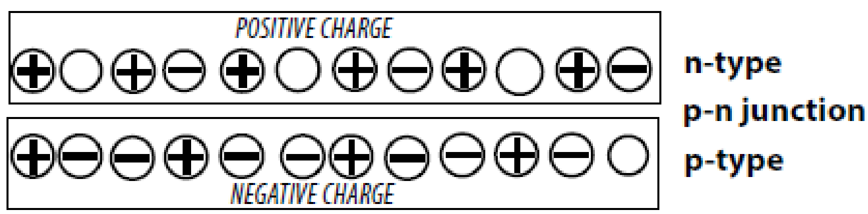
Photovoltaic Cell

○	A location that can accept an electron
−	Free electron
⊕	Proton
⊖	Tightly-held electron

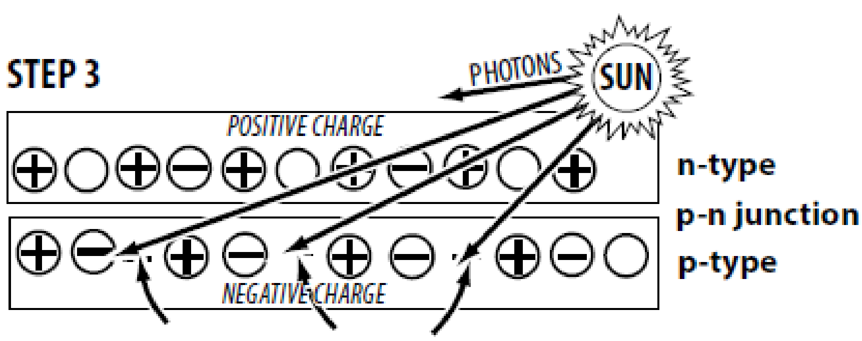
STEP 1



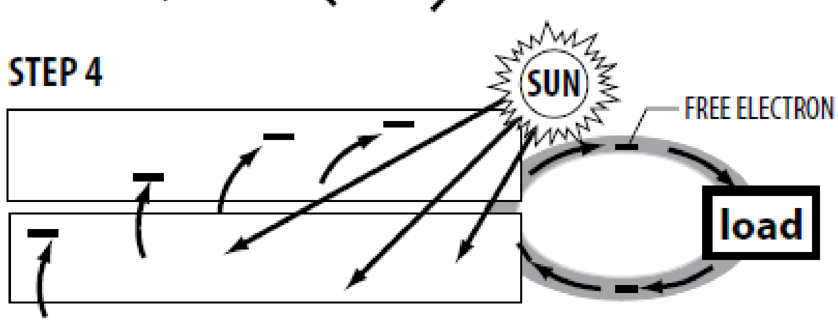
STEP 2



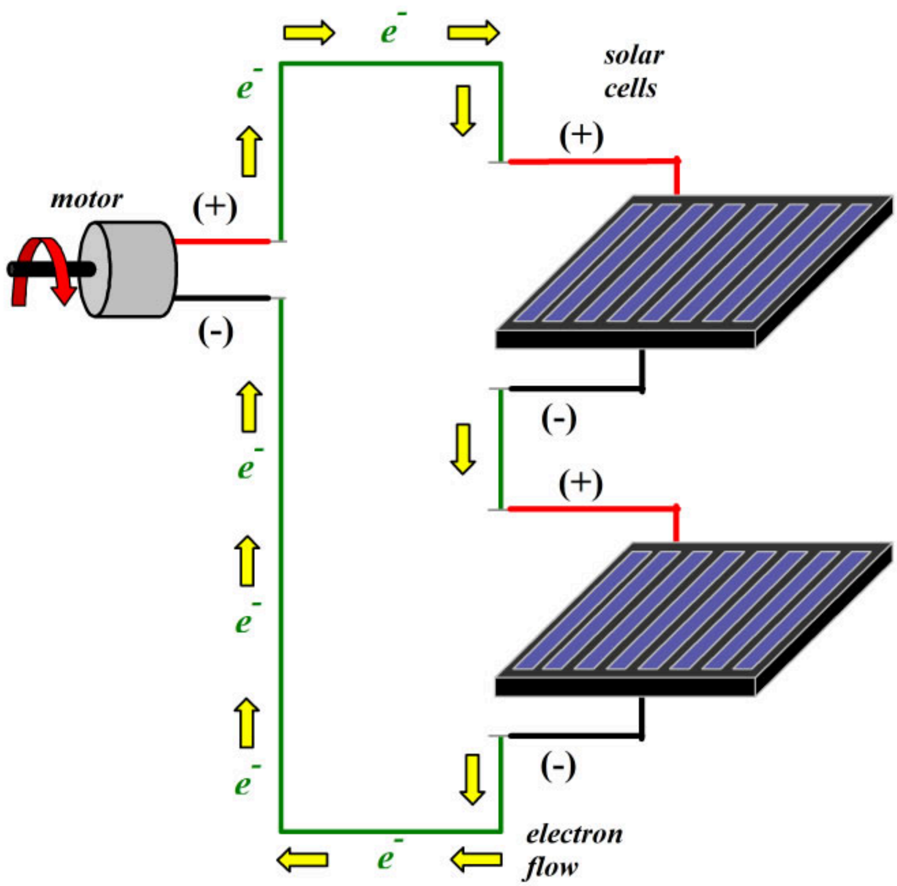
STEP 3



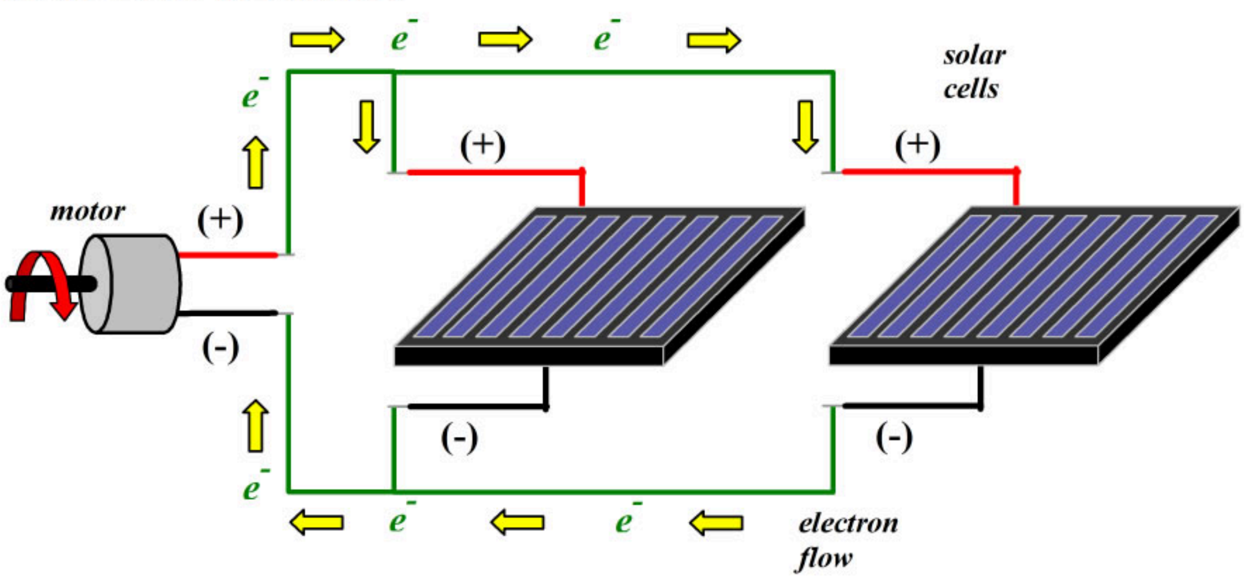
STEP 4



Solar Cells in Series



Solar Cells in Parallel



Using a Multimeter “Cheat Sheet”

Measuring Voltage:

- Voltage is the difference in electrical potential between two places in the circuit
- We therefore measure voltage **across** an element, meaning that we connect the multimeter in **parallel** with the element of interest
- To prevent the multimeter from changing the circuit, we want **very little current** to flow through the meter, so the meter needs to have a **very high resistance**

Measuring Current:

- Current is the measure of how fast electrical charges move through a branch of the circuit
- We therefore need all of the current passing **through** an element to pass through the multimeter, meaning that we connect the multimeter in series with the element of interest
- To prevent the multimeter from changing the circuit, we want **as small a voltage drop** across the meter as possible, so the meter needs to have a **very low resistance**

Setting the Dial:

- There are four settings on the multimeter. In general, we will be using DC voltage (V⎓) measured in “Volts” and DC current (A⎓) measured in “Amps,” hence the “V” and “A” designations on the multimeter.
- The numbers along the dial represent **ranges of measurement**. For instance, the first range of measurement on the voltage side of the meter in the images above is from 200mV to 2V. If your expected reading is less than 200mV, you should set the dial to 200m. If it’s greater than 200mV, but less than 2V, you should set the dial to 2, etc. The values get larger in the clockwise direction around the dial.

https://www.cebrightfutures.org/sites/default/files/multimeter-cheatsheet_0.pdf

Solar Panel Experiments

MATERIALS
Solar panel connected in series or parallel
Multi-meter
Incandescent light
Yard stick
Protractor
6”x6” cardboard

PROCEDURE

Using the equipment provided, connect the solar panel to the multimeter

Distance from the light source – seasonal variation

1. Start with the solar panel positioned parallel to the light source at 10cm from the source
2. Read the voltage
3. Slowly move the solar panel away from the light source while keeping an eye on the voltage.
4. What happens to the voltage as you move further from the light source?
5. Do you think these results will differ depending on if the panel is wired in series or parallel?

Angle of the panel – geographic variation

1. Start with the solar panel positioned parallel to the light source at 10cm from the source
2. Read the voltage
3. Slowly tilt the solar panel away from the light source while keeping an eye on the voltage.
4. Repeat step 3 but tilt the panel toward the light source.
5. What happens to the voltage as you tilt the panel? Is the result different when you tilt it away versus toward?
6. Do you think these results will differ depending on if the panel is wired in series or parallel?

Covering the panel – shading

1. Start with the solar panel positioned parallel to the light source at 10cm from the source
2. Read the voltage
3. Using the cardboard, cover the left half of the panel while keeping an eye on the voltage.
4. Repeat step 3 but cover the right half, top half, bottom half and any other combinations you would like to try.
5. What happens to the voltage as you cover the light source? Is it different if you cover different parts of the panel?
6. Do you think these results will differ depending on if the panel is wired in series or parallel?

https://slideplayer.com/slide/8814984/

PHOTOVOLTAICS

Photovoltaic (PV) cells absorb solar radiant energy and convert it to electricity. A motor converts electricity into motion.

PURPOSE: To explore PV cells.

Step 1: Attach the motor to the PV cell by removing the screws on the posts of the PV cell, sliding one connector from the motor onto each post, then reconnecting the screws.

Step 2: Attach the fan to the stem of the motor so that you can see the motion of the motor.

Step 3: Place the PV cell in bright sunlight. Observe the rate of spin of the fan.

Step 4: Cover part of the PV cell with your hand. Observe the rate of spin of the fan.

Step 5: Hold the PV cell at different angles to the sun and observe the rate of spin of the fan.

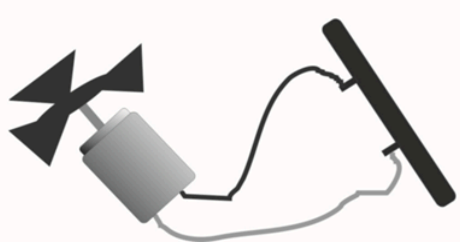
Step 6: Use a bright artificial light source, such as an overhead projector, and observe.

Step 7: Cover part of the PV cell and change its angle to observe changes in the rate of spin.

Step 8: Hold the PV cell at different distances from the light source and observe changes in the rate of spin of the fan.

Step 9: Observe the direction of the spin of the disc. Remove the wires from the PV cell posts and connect them to the opposite posts. Observe the direction of the spin.

OBSERVATIONS AND CONCLUSIONS: What have you learned about PV cells and their ability to convert radiant energy into electricity? How does changing the area of the PV cell exposed to light affect the amount of electricity produced? How does changing the angle of the PV cell to the light affect the amount of electricity produced? How does changing the distance from the light source affect the amount of electricity produced? Can you tell from your experiment whether artificial light produces as much electricity as sunlight? Why or why not? How does reversing the wires affect the direction of spin of the disc? Why?



Kits available from

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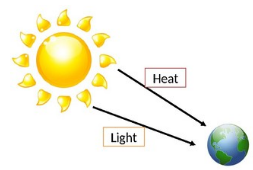
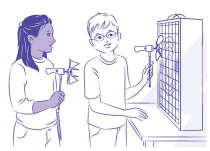
Exploring Wind Energy

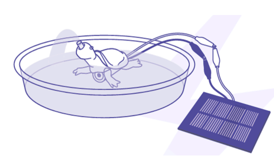
Exploring Solar Energy



Wind Powered Light (Firefly)



Solar Powered Water Fountain



Educator Kit: Wind Energy

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