Light

Goals

- Use a solar panel to generate electricity from light
- Run a motor with the electricity generated
- Use the speed of the motor to measure light energy

Background

Light is a strange phenomenon. You've probably been using two highly sensitive light detectors since the day you were born, and they're helping you to read these words right now. But what we see as light is just part of a diverse type of energy that exists all over the universe and has many uses here on our own planet as well.

Light is just a small part of something known as the electromagnetic spectrum, a form of energy that travels through space as waves. You can see only part of that spectrum with your eyes, which your brain interprets as colors. Difference in wavelength (the distance between the peaks of the waves) result in different colors. The colors you can see range from red at the long end of the spectrum to violet at the short end.

But there are many more "colors" beyond those that you can't see, although you may have heard of their names. We call the colors with wavelengths too short to see "ultraviolet" and those with wavelengths too long to see "infrared." Other types of electromagnetic waves, like X-rays and gamma rays, have even shorter wavelengths than ultraviolet. Radio waves and microwaves have even longer wavelengths than infrared.

Solar power is a way of generating electricity that uses the energy contained in these waves to create an electric current. During this activity, you'll use a solar panel to generate an electric current and describe how it works.

Procedure

1. Use your solar cell to power the small motor that controls the fan. You'll need to connect the solar cell to the fan using wires to carry the electricity. Why do you think you need two wires?
2. When you've connected the solar cell to the motor, you may have to give the fan a little push to get it started. The solar cell will work best in direct sunlight. What happens to the fan if you try the solar cell with other light sources?
3. You can use the electricity from the solar panel to generate hydrogen gas using the electrolyzer. The electrolyzer is the square with "H2" and "O2" printed on either side. What do you think will happen if you connect it to a source of electricity like the solar cell?
4. Your electrolyzer is also a hydrogen fuel cell that can generate electricity from hydrogen and oxygen. It has two small tubes attached to it. Is there anywhere else on the fuel cell that you could attach the longer tubes?
5. Look at the remaining pieces of your kit. If the fuel cell splits water into hydrogen and oxygen gases, what could you use to trap the gases so they don't float away?

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6. Connect the tubes of your fuel cell so that you can trap the gases. To generate hydrogen, you'll need to supply an electric current. You can do this with the battery pack or the solar cell. Try both. Which is better at producing hydrogen? How do you know?
7. When you've produced hydrogen, you can use the fuel cell to power the motor just like you did with the solar cell. Plug the motor into the fuel cell and it should start turning. Note in your observations if you see any difference in how the motor works with the fuel cell instead of the solar cell.
8. When you've produced hydrogen, you can use the fuel cell to power the motor just like you did with the solar cell. Plug the motor into the fuel cell and it should start turning. Note in your observations if you see any difference in how the motor works with the fuel cell instead of the solar cell.

Observations

Experimentation

1. You can use colored plastic gels, or different lightbulbs, to change the color of light hitting the solar panel. Do certain colors work better than others? Try using the solar panel to run the electrolyzer while the panel is hit with different wavelengths of light and record your observations below:

Light Color:	Time to fill H2:	Observations:

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2. The solar panel is dark in color. Does the color of its surroundings affect how well it collects light for generating electricity? Try using the panel to run the electrolyzer while the panel is in front of different colored backgrounds and record your observations below:

Background Color:	Time to fill H2:	Observations:

3. Attach the solar panel to the motor and use a piece of paper or other method to shade parts of the panel and observe the effects. How much of the solar panel can you cover before the motor stops running? Does it matter which side of the solar panel is shaded?

Measurement

For this section, you will need a multimeter or the Horizon Renewable Energy Monitor. For an introduction to using a multimeter, click here.

1. Attach the motor to your solar panel. Measure the current in Amps and the voltage in Volts while shading the solar panel to find the minimum values for each that will still run the motor. Record your answers below:

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Current: _____ A

Voltage: _____ V

2. Voltage is equal to the current multiplied by the resistance (V = IR), so according to your data what is the resistance of the motor?

Resistance: _____ Ω

3. Use different colors of light with your solar panel as before. Measure the current in Amps and the voltage in Volts while running the motor. What color gave the highest values? Record your answers below:

Color: _____

Current: _____ A

Voltage: _____ V

Analysis

1. Make a scientific claim about what you observed while running the solar panel.

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2. What evidence do you have to back up your scientific claim?

3. What reasoning did you use to support your claim?

4. Design an experiment that could test the relationship between the energy of light and its wavelength.

Conclusions

1. Based on your observations, do you think a solar panel would be useful for generating electric energy from any type of light? Explain your reasoning.

2. What would you say is the most important factor in determining how much electric energy a solar panel produces?

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3. Based on your observations, what color of light emits the most energy?

4. Based on your observations, what color of background absorbs the most energy?