Solar Powered System

Student Objective
The student:
- understands that light energy from the Sun can be turned into electricity with a photovoltaic (solar) cell.
- knows variables such as clouds, shading and direction of panel tilt, that can affect the amount of power that the photovoltaic cell produces.

Key Words:
load
photovoltaic (PV)
system

Time:
1 class period

Materials:
- small photovoltaic cell with wires attached (1 per group)
- motor (1 per group)
- propeller (1 per group)
- Science Discovery Sheet

Background Information

Photovoltaic cells (called PV or solar cells) are made of silicon (sand). The silicon is heated to extreme temperatures. It is doped (coated/mixed) with chemicals, usually boron and phosphorous. This sets up an unstable environment within the photovoltaic cell. When light strikes the cell, electrons are excited and travel along wires placed within the cell. The electrons follow the wire and power whatever load is attached, in this case a motor. This flow of electrons is called electricity. Photovoltaic systems are quiet, clean, and non-polluting.

For further information on how photovoltaics work and to view an animation of the process, visit the Department of Energy photovoltaics page at:
http://www.eren.doe.gov/pv/howworks.html

Procedure
1. Discuss with the class what a photovoltaic (PV – 'solar') cell does (turns the Sun's energy directly into electricity).
2. If you have played the Solar Cell Simulation game in *Solar Matters*, remind the students of the 'flow' of electrons in the system.
3. Dived the class into groups of 2 - 3 students per group.
4. Give each group of students a photovoltaic cell, motor and propeller.
5. Demonstrate how to attach the propeller to the motor. Have the students attach theirs.
6. Demonstrate how to attach the cell wires to the motor wires – red to red, black to black.

Have the students attach their wires.

7. Demonstrate the holding position of the system (i.e. face up, directed towards the Sun), making sure that the wire connections do not touch each other.
8. Take the "solar powered systems" outside and activate them in the sunlight.
9. While outside, discuss results and suggest things for the teams to try. Points to cover could include:
   - What happens when the panel is turned over away from the light?
   - What happens when part of the panel is shaded with your hand? How much of the panel can you shade before the motor stops?
   - Observe the rotation of the propeller blades, which way are they turning? What happens when the wires are attached the opposite way (red to black)?
   - Does the angle of the cell in relation to the Sun make a difference in how fast the propeller turns?
9. After returning to the classroom, discuss variables that can affect the output of the photovoltaic cell such as:
   - time of day
   - weather conditions
10. Students should then draw a solar powered system on their Science Discovery Sheet. Encourage them to be creative as to what device their system powers.

Further Activities

1. Show the class pictures of other solar powered systems. Several different types of systems can be found in *Solar Wonders* on the Florida Solar Energy Center website at: http://www.fsec.ucf.edu/ed/sw/index.htm
2. Lead a discussion of photovoltaic systems in your community. Some examples could be remote signs, roadside call boxes, signal buoys, weather stations, electric fencing or emergency shelters.

Further Reading

- ***Little Factory*** by Sarah Weeks and Byron Barton (Laura Geringer, 1998)
  This book and accompanying cd-rom, tell the story (and sing the song) of a little man who builds a little factory and the little workers who come to run the machinery and work on the conveyor lines. When the factory expands and becomes crowded and full of smoke which chokes the employees, they leave. The owner then cuts back, switches to solar energy and everyone returns. The frequently recurring refrain of 'la-dee-dah, la-dee-dah' makes this story also great for sing-alongs.

EnergyWhiz

Assist other classes in performing this exercise. Submit a video of your demonstration to the EnergyWhiz website at: **http://energywhiz.com/** Include your name, school, city and the grade you teach. Your video may be chosen for our website or to be used in our professional development workshops.

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			.1	.2	.3	.4	.5
Energy	**Standard 1**	**SC.B.1.1-**	**X**		**X**		
	Standard 2	**SC.B.2.1-**	**X**				
Art Standards:	**VA.A.1.1.1, VA.B.1.1.4**						

Benchmark SC.B.1.1.1 - The student knows that the Sun supplies heat and light energy to Earth.
Grade Level Expectations
The student:
Kindergarten
- knows the effects of sun and shade on the same object.

Benchmark SC.B.1.1.3 - The student describes a model energy system.
Grade Level Expectations
The student:
Second
- understands that models can be used to illustrate how energy flows through a system.

Benchmark SC.B.2.1.1 - The student recognizes systems of matter and energy.
Grade Level Expectations
The student:
Second
- understands ways energy and matter interact.

Benchmark VA.A.1.1.1 - The student uses two-dimensional and three-dimensional media, techniques, tools, and processes to depict works of art from personal experiences, observation, or imagination.

Benchmark VA.B.1.1.4 - The student uses the elements of art and the principles of design to effectively communicate ideas.

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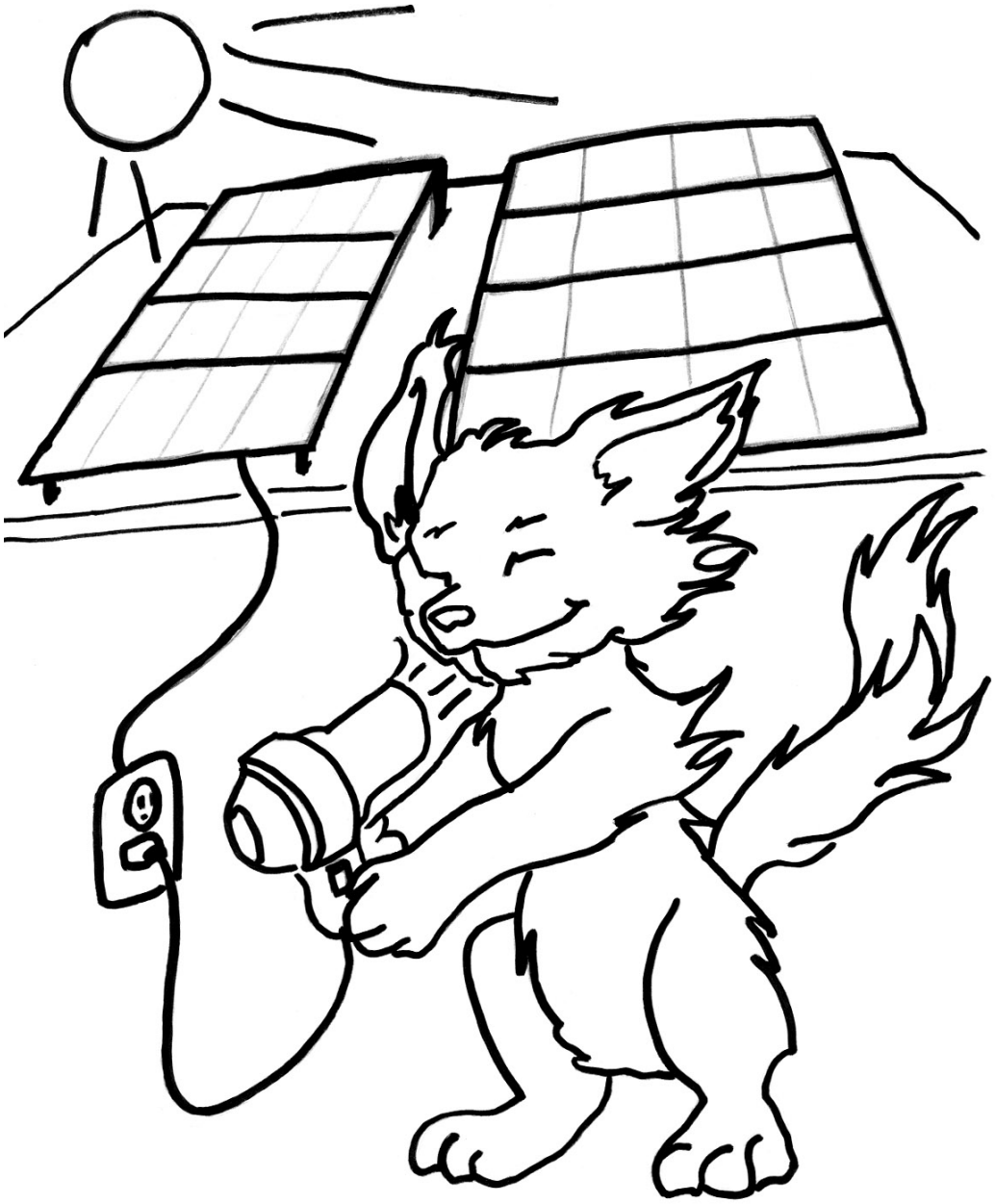
load - a device to which power is delivered, such as a motor, a light, or a household appliance.

photovoltaic (PV) - the effect of producing electric current using light.
'photo': light
'voltaic': relating to electricity (volt)

system - a group or combination of things or parts forming a complex or unified whole.

Solar Powered System

Color this solar powered system.



Draw a solar powered system below.