Solar Cell Simulation

Grades: K-4

Topic: Solar

Owner: Florida Solar Energy Center

This educational material is brought to you by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

Solar Cell Simulation

Student Objective
The student:
- will be able to describe how energy moves from the Sun to the photovoltaic cell to the wire and to the load
- will be able to explain what happens when a photovoltaic cell is shaded.

Key Words:
current
electron
load
photon
photovoltaic
simulation

Materials:
- open area (field or playground)
- chalk or traffic tape to outline areas
- bell
- 40 ft string or rope, with 10 knots 2 feet apart (the rest is unknotted) Knot the two ends of rope together in a large circle

Time:
½ hour

Background Information

Photovoltaic refers to the process of turning the energy of the Sun directly into electrical current through the use of photovoltaic cells. These cells (commonly called solar cells) are manufactured in several different ways, however the most common method uses silicon that undergoes a chemical process to add electrons and increase its instability. The silicon mixture is allowed to form crystals from which the photovoltaic cells are made. Electricity is produced when a photon of light energy strikes the solar cell, exciting the electrons. This action causes the electrons to 'flow', starting an electric current. The conversion of sunlight to electricity happens silently and instantly with no moving parts to wear out, no emissions and without a depletion of resources.

Photovoltaic technology is relatively new; as a viable energy source, it is less than 50 years old. However, it has great potential for the future. As a source of energy, sunlight is free, its supplies are unlimited and it is available in the majority of areas of the world. However, at this time the relatively high cost of photovoltaic cells and systems is limiting its use. This is expected to change as our supplies of fossil fuels diminish, new methods of producing photovoltaic cells are discovered, and the increase in demand for the technology brings the price down.

Procedure

1. Explain to the students what 'simulation' means.
2. Outline an area on the ground approximately 10 feet by 10 feet to represent the photovoltaic (PV) cells.
3. Outline another area representing the Sun as a large circle 15 feet in diameter.
4. Half of the students spread out in the PV cell, holding onto the rope at a knot. They represent the electrons in the cells.
5. The other students stand in the Sun and represent the photons emerging from the Sun.
6. Place the bell outside the PV cell and have the student with the last knot on the rope before the unknotted part stand near the bell. The rope then circles back into the cell (without knots) simulating the electrical circuit.
7. Explain the following to the class:
    - one student who represents a photon will walk and join hands with the first student (electron) inside the PV cell. This gives the electron energy and it starts to move
    - the photon and electron holding hands move together down the rope to the next electron and tag it. This student then moves down the rope to tag the next student. This movement and tagging continues until the energy reaches the last student on the knotted part of the rope
    - this student activates the load on the circuit (rings the bell). The whole class yells out "Hurray for solar energy". The electron student circles around on the unknotted part until they come back to the first knot (now vacated), ready to be tagged
    - another photon leaves the Sun, and the movement continues in the same way (the photon pairs up with an electron, moves down the rope, tags the next electron, until the bell is rung, class chants, electron travels back on the circuit to the PV cell, etc.)
    - continue this movement until all the photons are gone from the Sun.
8. Gather students together and lead a discussion about what happened. Make sure that students understand what real-world things the different groups represented. Ask students how they would change the simulation to represent a cloudy day.

Further Activities

1. Simulate a cloudy day. On a partly cloudy day, the students could mimic the actual conditions by representing clouds when an actual cloud passes over, and sunshine when it is clear.
2. Have the last electron call out the name of an appliance or electrical device that they are powering (instead of ringing the bell). Each device may only be named once.

EnergyWhiz

Submit a picture of your class performing the Solar Cell Simulation to the EnergyWhiz website: **http://energywhiz.com/** Include your name, school, city and grade you teach.

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Energy	**Standard 1**	**SC.B.1.1-**	**X**		**X**		
	Standard 2	**SC.B.2.1-**	**X**				

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.

Solar Cell Simulation

current - the flow of an electric charge

electron - negatively charged particle of electricity

load - a device on an electric circuit to which power is delivered

photon - the small pieces of light

photovoltaic (PV) - the effect of producing electric current using light

simulation - the imitation of the way in which a system or process works