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# Solar Cell Simulation

Lesson plan for grades K-3
Adapted by Laura Sanders, Environmental Science Institute, 11/22/2010
Source: Florida Solar Energy Center (FSEC) Teacher Resources:
http://www.fsec.ucf.edu/en/education/k-12/curricula/sm1/documents/SM1_solar-cell-simulation.pdf

**Time**: 30 minutes

## Objectives

Students will be able to:

- Describe how energy moves from the Sun, to the photovoltaic cell, to the wire, and to the load.
- Simulate and explain what happens when a photovoltaic cell is shaded.

## Sample TEKS

§112.11. Science, Kindergarten: 1C, 8C
§112.12. Science, Grade 1: 1C, 6A, 8B
§112.13. Science, Grade 2: 1C, 6A, 8B
§112.14. Science, Grade 3: 1B, 3C, 6A, 8B

## Vocabulary

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

## Background Information

*Photovoltaic* refers to the process of turning the energy from 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

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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 supply is unlimited, and it is available across the globe. 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.

**Materials**

- Open area (field or playground)
- Chalk or traffic tape to outline areas
- Bell
- 40-ft sturdy string or rope, with 10 knots spaced 2 feet apart, and knotting the two ends of the rope together in a large circle (leave the remaining rope unknotted)

**Procedure**

1. Discuss the concept of "simulations." Discuss safety considerations for classrooms outside.
2. Once outside, outline an area on the ground approximately 10 feet by 10 feet to represent the photovoltaic (PV) cells. Outline another area representing the Sun as a large circle about 15 feet in diameter.
3. Ten students should stand in the area designated as the PV cell, holding onto the rope at a knot. They represent the electrons in the cells. 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. The rest of the students stand in the Sun and represent the photons emerging from the Sun.
4. Explain the following rules for the simulation:
    a. One student who represents a photon will walk and join hands with the first student that represents an electron inside the PV cell. This gives the electron energy and it starts to move.
    b. 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.
    c. The last student-electron "activated" activates the load on the circuit (rings the bell). (At this point, the class can shout out "Hurray for solar energy!" or something similar to celebrate the ringing of the bell.) This last student then circles around on the unknotted part until they come back to the first knot (now vacated), ready to be tagged by a photon.

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   d. 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, etc.). Continue the cycle until all photons have left the sun.

5. Gather students together and encourage discussion about what happened. Be sure that students understand what real-world things the different groups represented.
   a. Do actual photons leave the sun one at a time?
   b. What happens to all the other photons? (In real life, the sun shines on more than just one small area has we have simulated.)
6. Ask students how they would change the simulation to represent a cloudy day. Simulate a cloudy day. What would happen when a cloud passes between the sun and the solar cell on Earth?

**<u>Going Further</u>**

1. Part of the energy from the sun we can detect through our sense of sight. How far are these photons traveling? What about the light energy from other stars – how far are their photons traveling to reach us?
2. Encourage class discussion on appliances or electrical devices that could be powered by the class' PV cell (instead of ringing the bell).