



SOLAR ENERGY FOR THE CLASSROOM



Provided by Pierce Cedar Creek Institute
www.cedarcreekinstitute.org

Activity Overview

Grade Level: 6-8

General Description

For this activity, students design and test a solar-powered battery charger.

Learning Outcome

After designing and testing a solar-powered battery charger, students will be able to describe the relationship between the direction of electrons flowing through a battery and a change in the battery's voltage.

Science Content Standards

Content Area: Constructing New Scientific Knowledge (C) I.1.1

Standard: All students will generate scientific questions about the world based on observation.

Content Area: Constructing New Scientific Knowledge (C) I.1.2

Standard: All students will design and conduct scientific investigations.

Content Area: Constructing New Scientific Knowledge (C) I.1.3

Standard: All students will use tools and equipment appropriate to scientific investigations.

Content Area: Constructing New Scientific Knowledge (C) I.1.4

Standard: All students will use metric devices to provide consistency in an investigation.

Content Area: Constructing New Scientific Knowledge (C) I.1.6

Standard: All students will write and follow procedures in the form of step-by-step instructions, formulas, flow diagrams, and sketches.

Storing Solar Energy in Batteries

Background

The most common method of storing solar electricity is to use it to charge batteries. Building a solar-powered battery charger is an inherently safe activity for students because of the way solar cells self-limit the amount of current they produce. Recharging a battery at too fast a rate (too high a current) might cause a buildup of gas inside the battery, potentially causing it to explode. Charging batteries with mini-solar panels eliminates this potential safety hazard.

The voltage of a power source indicates its ability to force electrons through an electrical circuit. When a battery is connected to a circuit (such as when you turn on the switch of a flashlight to connect its battery to its light bulb), it forces electrons out of its negative terminal (marked with a minus [-] sign), through the circuit, and into its positive terminal (marked with a plus [+] sign). This action slowly changes the chemical makeup of the battery. With use, this change reduces the voltage of the battery and at some point the battery can no longer force the electrons through the circuit. At this point we say the battery is "dead."

For some dead batteries, another power source can be used to force the electrons to flow in the opposite direction and cause the chemical makeup of the battery to return to its original state. The battery is then "recharged." In order to do this, the voltage of the other power source must be greater than the charged voltage of the battery.



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Science Content Standards

Content Area: Reflecting on Scientific Knowledge (R) II.1.4

Standard: All students will describe the advantages and risks of new technologies.

Content Area: Ecosystems (LEC) III.5.6

Standard: All students will describe ways in which humans alter the environment.

Content Area: Matter and Energy (PME) IV.1.5

Standard: All students will construct simple circuits and explain how they work in terms of the flow of current.

Content Area: Matter and Energy (PME) IV.1.6

Standard: All students will investigate electrical devices and explain how they work using instructions and appropriate safety precautions.

Content Area: Changes in Matter (PCM) IV.2.4

Standard: All students will describe common energy transformations in every day situations.

Materials (per classroom)

- Digital multimeter*
- 4 “Dead” rechargeable AA batteries* **
- AA battery holder*
- Alligator clamps*
- Masking tape
- Solar panel*
- Gooseneck lamp with 150-watt incandescent bulb (if sunlight is not available)

*Provided in the *Solar Energy for the Classroom* kit; other materials are to be supplied by the teacher.

**The rechargeable batteries are new and fully charged. Please be sure to draw down the batteries before performing this activity.

Methods

1. Ask students to describe what they know about batteries and recharging batteries.
2. Show students how to use a digital multimeter to read voltages.
3. Have students record voltage measurements for the solar panel, “dead” battery, and the charged battery.
4. For a classroom demonstration, small batteries such as size “AA” can be charged in a relatively short period of time. Use only rechargeable batteries and ensure that their power has been drawn down.
5. On paper, have students design a battery charger by drawing a diagram showing how to connect the solar panel and the dead batteries so that when the solar panel is placed in light, electrons will flow from the solar panel into the negative terminal (-) of the battery.



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6. Once students have drawn a circuit they believe will work, have them build and test it. Students should place the AA rechargeable batteries in a battery holder and connect the positive end of the batteries to the positive side of the solar panel using the alligator clips. They should also connect the negative end of the batteries to the negative end of the solar panel.
7. Place the solar panel and batteries in full sunlight for a day (The lamp and 150 watt incandescent bulb can be used as well).
8. Have students determine if the batteries are being charged by solar energy. If their ammeters do not show them that electrons are flowing into the negative terminal of the battery, check all of their connections. If this is not the problem, have students redesign their circuit and rebuild and retest it.

Discussion/Assessment

- Review how to tell if a battery is recharged:
 - a. The batteries are recharged when the ammeter stops indicating that any electrons are moving (The batteries have stopped drawing current from the solar panels).
 - b. Test the batteries in an appliance such as a small radio.
- Have students explain what happens if the positive end of the batteries are connected to the negative side of the solar panel.
- Have students brainstorm practical reasons (particularly ecological and economical) for storing solar energy (i.e. the cost of disposable batteries, the environmental hazards of battery acids ending up in landfills and groundwater, etc.).
- Suggestion: Keep your solar battery charger on hand in the classroom throughout the year so that students can charge and recharge (rechargeable) batteries for their own use at home. This is one simple means of increasing students' awareness of solar electricity as a viable way to produce electricity for their daily lives.

Source: This activity is adapted from an activity designed and run by Richard Komp, PH.D, President of the Maine Solar Energy Association and of the Sun Watt Corporation.