Solar Car

P6-7405

INSTRUCTIONAL GUIDE

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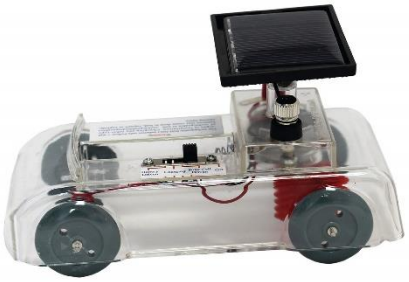
- Assembled Solar Car
- Instructional Guide

Recommended for activities:

- Slotted Mass Set (P1-1073)
- Digital Multimeter (P6-8017)



Background

The Solar Car demonstrates the energy transformations of solar (radiant) energy to electrical, and from electrical energy to mechanical (kinetic). This design eliminates the need for fossil, carbon-based fuels and their resulting CO2 emission. The Solar Car can provide the option of running directly on solar energy or run off the battery that is charged by the car's solar cell.

Set-Up

1. Insert a rechargeable Nickel Metal Hydride (NiMH) AA battery into the battery compartment. Do not use non-rechargeable batteries. The car CAN ALSO RUN WITHOUT BATTERIES, in Solar Cell Driven mode.
2. Adjust the angle of the solar panel to provide maximum direct solar energy.
3. Slide the switch to the desired setting as follows:
    a. Solar Cell Driven Mode: Place the car in a sunny location on a smooth surface. Angle the solar panel so that it faces the sun. The car is powered directly by the solar panel so the battery can be removed to reduce weight.
    b. Battery Charging Mode: Place the car in a sunny location with the solar panel angled toward the sun. The batteries will charge at a rate that depends on the sun intensity. Full charge may be reached in as little as two hours.
    c. Battery Driven Mode: The solar panel is disconnected from the circuit in this setting, and the car runs on battery power alone.
    d. Off: All circuits are disconnected.

Experiments

1. Observe the efficiency of the solar panels. The solar panel can provide a higher voltage than a 1.5-volt AA battery which explains how the solar panel is able to recharge the batteries.
2. Power the car in battery mode for constant velocity motion measurements. Measure the time it takes to travel a set distance, and calculate its speed.

3. Move the solar panel to different angles, and compare the resulting speed of the car.
4. How much shadow can the car coast through without stopping?
5. What is the effect of different surface types on the motion of the car? Imagine that you are an automotive engineer. What consideration must you give to different road surfaces, as you design a car?
6. Use a Digital Multimeter (P6-8017) to measure the voltage from the solar panel in different amounts of sun. Don't forget to try different types of indoor lighting too! What is the minimum voltage needed to turn the motor with the wheels off the ground?
7. Add some weight to the car and measure its speed. How does added mass affect its efficiency? Battery weight is a challenge for designers of real solar, electric, and hybrid cars. How does the car run with just one battery? To minimize the car's weight, remove the battery and use sunlight to power the car directly!
8. Challenge students to redesign the car. How would they make it more efficient? Compare the resulting ideas to the cars entered in the American Solar Challenge. http://www.americansolarchallenge.org/.

*Advanced level tech-note: Beware of increasing the total battery voltage by stacking additional batteries in a series circuit as this could damage the solar panel.

Troubleshooting

1. The car will not run in Solar Cell Driven mode.
    a. Turn the solar panel so that it faces the sun directly.
    b. Run the car on a smooth surface such as a concrete sidewalk.

2. The car will not run in Battery Driven mode.
    a. Use a digital multimeter to check the battery charge. 1.2 V is considered a full charge.
    b. Be sure that the battery is properly installed.

3. The battery does not charge.
    a. Be sure that the battery is properly installed, with the positive terminals aiming forward.
    b. Use NiMH batteries. These are the most common rechargeable AA batteries available now.
    c. Be sure that the car is in full sun, with the solar panel facing the sun.
    d. Let the batteries charge for several hours if necessary.

Related Products

Renewable Energy Education Set (P4-2023) Use endlessly renewable solar power to create hydrogen fuel from water and learn the workings of a renewable energy system from start to finish. Explore clean energy sources and fuel cell technology.

Alternative Energy Conversion Kit (P6-2080) Students experiment with this alternative energy kit to discover for themselves how energy exists in many forms and how society can benefit from harnessing natural resources and making them into usable energy.

Solar Hydrogen Science Kit (P8-3520) The Solar Hydrogen Science Kit lets students invent their own clean energy applications using fuel cells and renewable hydrogen created using solar energy and water.