NAME ______________________________

DATE ______________________________

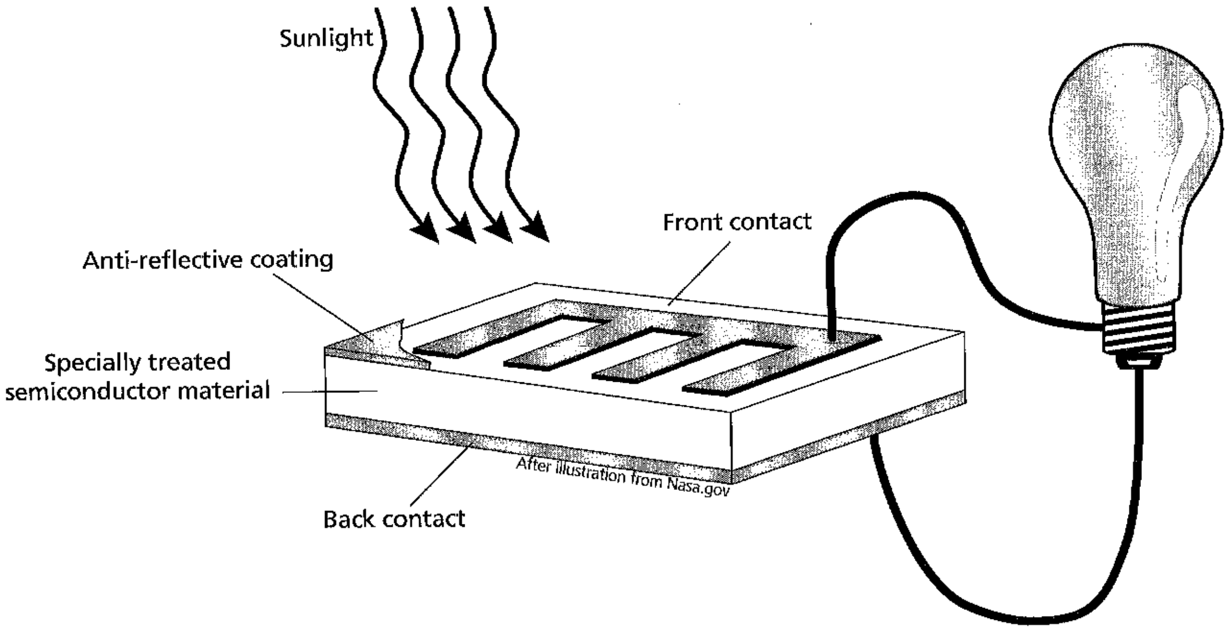
Carolina STEM Challenge®

Solar Car Design

Background

Solar cells, or photovoltaic cells (PV), convert light into electricity. *Photo* refers to light, and *voltaic* refers to electrical current. The first PV cell was built in 1954 at Bell Laboratories. Called a solar battery, it was too expensive to use commercially. In the 1960s, the space industry's need for electric power on orbiting spacecraft led to advancements in PV technology. The cost decreased, and the technology began to be used in more applications.

A typical solar cell today is composed of a specially treated semiconductor wafer of silicon or a similar element, such as germanium. This wafer is sandwiched between two plates, one positive and the other, negative. When photons of light strike the semiconductor, electrons are knocked loose from atoms of the semiconductor and flow through a closed circuit as electric current.



Multiple solar cells can be connected in series or parallel to make modules and panels that can produce any amount of direct current at a given voltage and amperage. Some common uses of small solar panels are for traffic signs, remote monitoring stations, outdoor landscape lighting, and charging cell phones, tablets, and laptops.

Energize Activity (Does Sunlight Angle Affect Voltage)

Objective

Your teacher will vary the angles of light on a 1.0-V solar cell to see if the angle of incident light makes a difference in voltage. This information will be used in designing your group's solar car.

Materials

flashlight
protractor
solar cell
multimeter
ruler
2 wires with alligator clips on each end

Procedure

1. A 1.0-V solar cell is placed flat on a demonstration table.
2. A red wire of the solar cell is clipped to the red wire probe of the multimeter. The black wire of the solar cell is clipped to the black wire probe of the multimeter.
3. The multimeter is set on the smallest scale to read 1.0 V DC or less.
4. A ruler is used to measure a distance of 30.5 cm from the solar cell. From the distance, the cell is illuminated with a flashlight at angles of 90°, 45°, and 20° as measured with a protractor. Record the voltage for each angle.
5. Determine which angle is the best for maximum voltage.

Design Activity

Objectives

During this activity, your group will design a solar car using the materials provided. The criteria for meeting this design and competition are as follows:

- Power must come only from the solar cell.
- The chassis must be made from the cardboard pad provided.
- A body will be added to the chassis, and the solar cell mounted on the body.
- The design must address length and width of chassis, wheelbase (distance between centers of front and rear tires), aerodynamics, friction, front-wheel or rear-wheel drive, best location for the solar cell, and weight.
- Groups will race their designs on a designated straight track of 5 meters. The lowest elapsed time (ET) in seconds for three trials will be recorded as the car's best time.
- Using the best ET, the speed of the car will be calculated in meters per second and miles per hour.
- Student groups will be judged in two categories—the best overall car design and the lowest ET for 5 meters.

Materials

DC motor
solar cell
bag of wheels, O-rings, gears, and axles
cardboard pad, 8.5 x 11 inches
drinking straw
ruler
scissors
transparent tape dispenser
timing device (stopwatch or timer)
hammer (this may be shared)
pliers (this may be shared)

Other materials may be available. Consult your teacher.