Solar Car

Overview: We're making our very own solar-powered cars as you discover important concepts about the sun's energy and how to capture it.

What to Learn This lesson reinforces the ideas from previous experiments: how sunlight provides energy for our use in a variety of ways.

Materials

- Solar Project Kit (Radio Shack #277-1201) or other solar cell with motor (usually sold in hobby stores)
- Foam block (about 6" long)
- Alligator clip leads (RS#278-1156)
- 2 straws (optional)
- 2 wooden skewers (optional)
- 4 milk jug lids or film can tops
- Set of gears, one of which fits onto your motor shaft (most solar motor kits come with a set), or rip a set out of an old toy
- Razor or scissors
- Stopwatch

Lab Time

1. Measure four inches from the end of your piece of balsa wood and cut in a straight line with the scissors or razor. Take the remaining piece and measure it so that you divide it in half lengthwise. Cut it with the razor. *Note: Adult supervision is needed for this step!*
2. Use the hot glue gun to join the two pieces, one on top of another.
3. Next, cut the straw into three pieces, each measuring as follows: 1 x 1 and 5/8", 1 x 1 and 7/8", and one extra leftover piece.
4. Now to attach the wheels to the body of the car. Take the second largest gear (it should be about the same size as the wheel), setting aside the other gears. Press the metal rod axle into the wheel, then thread the small washer in the car kit into the axle. Place the straw over the axle, and then attach the washer and wheel to the other side to complete the wheel and axle assembly. Check to make sure the axle spins freely by holding onto the straw. Attach the wheel to the base of the balsa wood with hot glue.
5. Start assembling the remaining wheels in the same manner, but after you add the shorter of the straws and washer, add the gear before closing the axle with the final wheel. Check to make sure that both the wheel and the gear spin freely when you hold the straw. Attach this axle to the body of the car with hot glue.
6. Attach the smallest of the gears to the shaft of the motor, and then align the motor so that the small gear meshes with the gear on the wheel and axle. Hot glue the motor in place when you've found the sweet spot.
7. Attach the solar cell to the body of the car with a small dab of hot glue. Take care to make sure the wires are facing away from the gears so that we don't have the wires flying all over the place.
8. Attach the wires by twisting them together according to their color.
9. Go outside on a nice sunny day and mark out a set distance for your cars to travel. Use a stopwatch to record how quickly they travel the distance. Compare these results to different weather patterns. Do you notice anything? Record all your data on the worksheet.

Solar Car Data Table

Date	Weather	Time

Total distance traveled:

Reading

Electrons orbit the nucleus of an atom in specific layers called shells, and which shell they are in depends on the amount of energy they have. When sunlight hits a solar cell, it knocks an electron free of its shell. Once an electron is knocked out of its shell, it's called a *free electron.* The free electrons start flowing through the silicon to create electricity. The solar cells are structured is such a way as to keep the electricity flowing only in one direction. The electron flow created is DC (direct current).

The solar cells you can buy from stores require huge amounts of energy in creating the solar cell, which is the primary downside. You need high temperatures, big vacuum pumps, and lots of people to make a set of solar cells. However, if we focus just on the physics of the solar cell, then we can easily create our own solar battery and other solar cell projects using household items. While these cells won't look as spiffy as the ones from the store, they still produce electricity from sunlight.

Solar energy (power) refers to collecting this energy and storing it for another use, like driving a car. The sun blasts 174 x 1015 watts (which is 174,000,000,000,000,000 watts) of energy through radiation to the earth, but only 70% of that amount actually makes it to the surface. And since the surface of the earth is mostly water, both in ocean and cloud form, only a small fraction of the total amount makes it to land.

A solar cell converts sunlight straight into electricity. Most satellites are powered by large solar panel arrays in space, as sunlight is cheap and readily available out there. While solar cells seem ”new” and modern today, the first ones were created in the 1880s, but were a mere 1% efficient. (Today, they get as high as 35%.) A solar cell’s efficiency is a measure of how much sunlight the cell converts into electrical energy.

Solar cells are usually made of silicon. Sunlight is made of packets of energy called photons. When photons hit the silicon, one of three things can happen: the photons can pass straight through the silicon if they have a low enough energy; they can get reflected off the surface; or (and this is the fun part) they get absorbed and the electrons in the silicon get knocked out of their shell. Once they get knocked out, they start flowing. Once this happens, voila! We have electricity!

Exercises Answer the questions below:

1. Most solar cells are made of what material?
    a. Hydrogen
    b. Aluminum
    c. Silicon
    d. Titanium
2. Name one benefit of solar cells and one drawback of using them for electricity.
    a. Benefit:

    b. Drawback:

3. Electrical current begins flowing when:
    a. Sunlight hits an atom
    b. Electrons are knocked out of orbiting atoms
    c. Protons get charged
    d. An atom’s nucleus splits

Answers to Exercises: Solar Car

1. Most solar cells are made of what material? (silicon)
2. Name one benefit of solar cells and one drawback of using them for electricity. (Benefit=renewable, clean, less pollution, etc., Drawback=expensive, takes a lot of energy, have to mine for minerals)
3. Electrical current begins flowing when (electrons are knocked out of orbiting atoms)