SunnySide Up
Solar Car Kit

by **SunWind**

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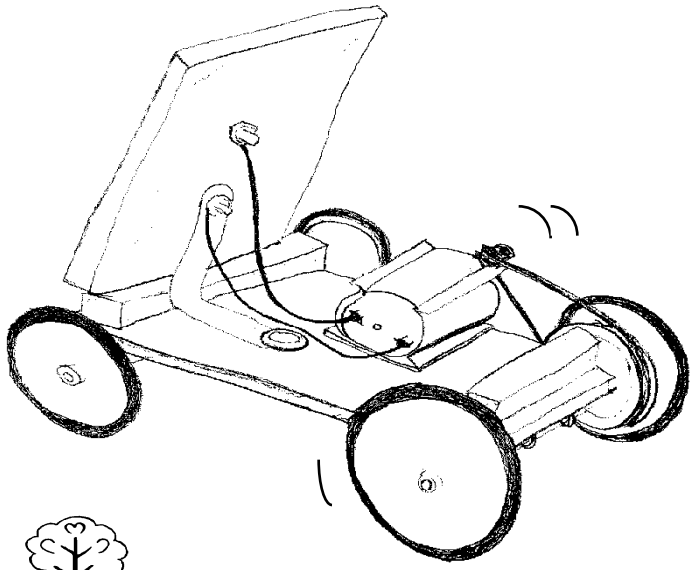
Jan 2003

Solar Energy: Our huge **Sun** (a middle-sized star) radiates **energy** as **electromagnetic radiation** into **Space** surrounding it, and some of that energy, travelling through the vacuum of Space, strikes the surface of our small rotating planet, 149 million kilometres (93 million miles) away. Solar Energy peaks in the visible light frequencies (over 40% of solar energy wavelengths we can **see**) and tails off into ultra-violet (6 to 7%) on one side, and into near infra-red frequencies (52 to 53%) on the other side. We perceive solar energy as **light and heat**. This energy warms Earth's air and oceans, is used by plants to create themselves mostly from carbon dioxide and water, and is used by our eyes to see. Light is a form of energy.

We can also convert the Sun's energy to **electricity,** another form of energy, using **photovoltaic** cells. [photo = light; voltaic = electric]. Crystalline PV cells are made of two joined layers of purified silicon whose pure crystals have trace amounts of different impurities added to each layer. These impurities cause electron-cloud instabilities in the otherwise orderly structures of the crystalline sheets. When photons of light energy strike the layers, some electrons are energized to jump across the electric field created at the junction of the sheets, and a flow of electrons is created, which we can guide through wires. This process is only about 1/8 efficient - that is, only about 1/8 of the solar energy received is converted to electricity. This direct electrical current is the same as electricity from batteries, and can be used to power many things. Solar cells allow light energy to directly become electricity; they can not store it. The **electric motor** converts electrical energy to mechanical motion.



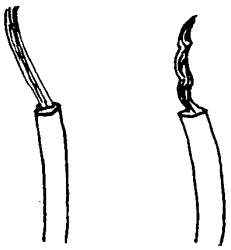
Materials List

	Purpose
solar panel, 400 milli-amp, 0.9 volt	- converts light energy to electrical energy
wires (2)	- conduct electrical current
motor	- converts electrical energy to mechanical energy
motor pulley	- transfers mechanical energy to drive belt
elastic bands (2)	- drive belt to transfer energy to driven pulley
pulley, 25 mm	- driven pulley, or wheel
dowels, 4 mm (2)	- axles (one is longer, for driven pulley)
wooden wheels (4)	- transfer energy from axle to ground
coroplast, 4 mm	- body
motor mounting clip	- holds motor firmly to body
fastener, 3/4"	- to hold solar panel to body
sandpaper (3 x 4 cm)	- to sand dowels, blocks
screw eyes (4)	- axle holders
wood blocks (2)	- to stabilize screw eyes
tubing	- to be cut into spacers for axles

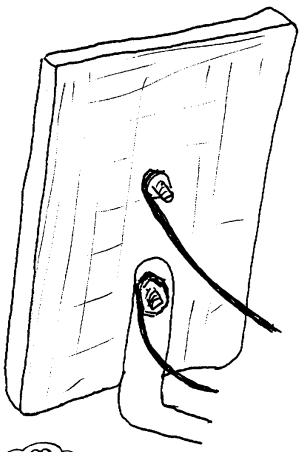
Tools: You may require something for making a hole (a **nail**, perhaps) when punching through the coroplast to mount the paper fastener, and perhaps to start holes in the wood for the screw eyes (though normally these screw right in). **Scissors** will be required to cut the tubing into 4 spacers (3 - 4 mm each will do). Wire strippers or scissors may be used to strip the insulation off the ends of the wires.

Connecting Wires

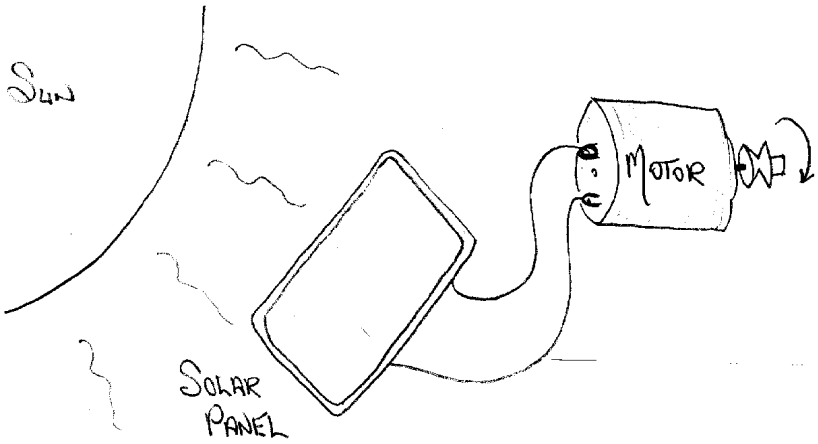
The first thing, of course, is to see that your solar panel and motor work. Strip 1.5 - 2 cm of the plastic insulation from both ends of two wires. A wirestripper, scissors, or small knife may be used. Twist the strands together, then insert one end of each wire into the holes in the metal tabs projecting from the back of the motor. Fold the wire over and twist it to form a tight connection. Attach a wire to each screw at the back of the solar panel, looping the bare wire around the screw, then tightening the nut. (Careful if you are using pliers...it is quite easy to tighten the nut too much and rip the screw from the back of the panel...the screw is hollow.)



Wires - strip insulation, then twist wire strands together.



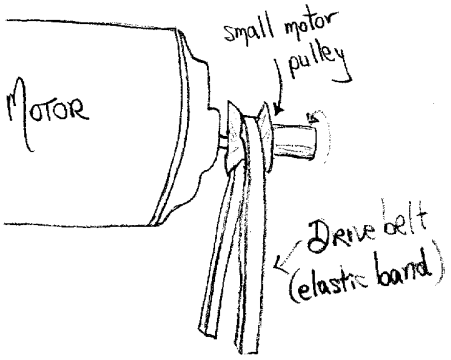
Attach a wire to each screw at the back of the solar panel.



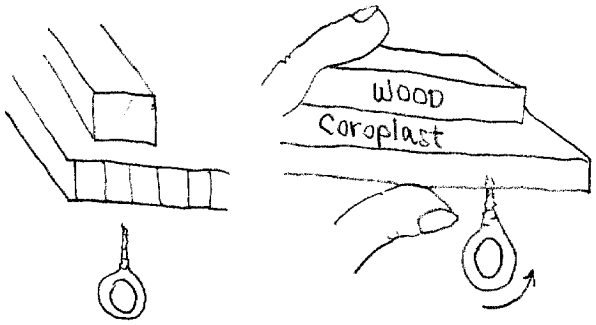
Test in strong sunlight (or a 100 watt bulb, fairly close, will do). If the motor does not turn, check your wire connections. If you must use a lamp, the panel should be held quite close to a 100 watt bulb...but be careful not to overheat the panel! If the motor does not turn, check your wire connections.

Note the direction the motor shaft turns. If you want the motor to spin in the opposite direction, **reverse** the wire connections at either the motor or the panel. Try this.

Now that you have a solar-powered drive unit, what can you do with it? What will the motor run? How can you transfer the mechanical energy?



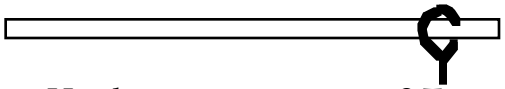
To Build a Solar Car



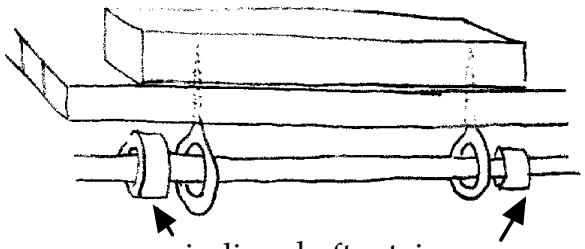
In-line wheels - Screw the screw eyes **through** the coroplast into the blocks of wood making sure that the axles will be <u>parallel</u> to each other.

Note that one axle is longer...this is for the driven pulley. A good car will have smooth running gear. Using **scissors**, cut four 1/2 cm sections of tubing. Mount these on the axles as "in-line shaft retainers". These keep the axles from sliding sideways, and therefore the wheels from knocking against the body. Mount the spacers loosely (not too tightly against the screw eyes) so that the axles turn freely.

<u>Sometimes</u> a screw eye is hard to start into the wood. Use a sharp object (such as a **nail**) to provide a starter hole.

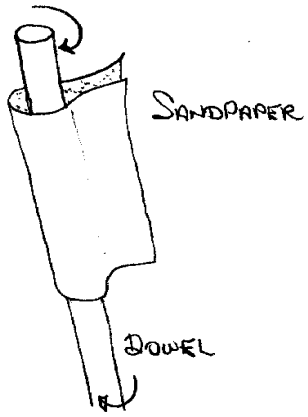


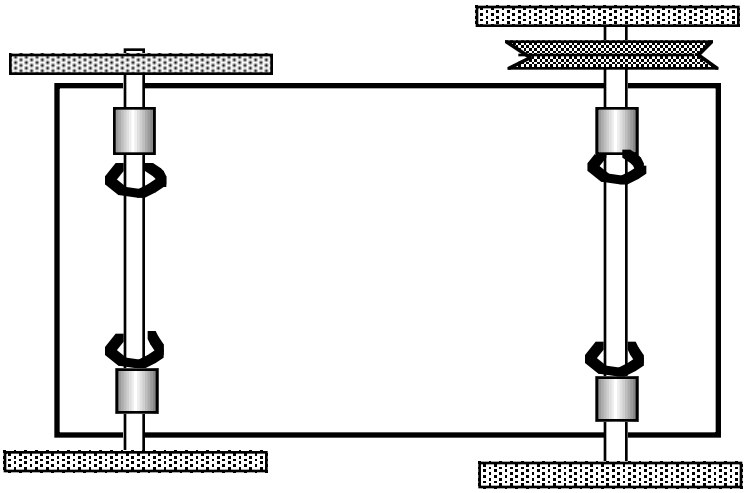
Hard turning screw eyes? Try a dowel as a <u>lever</u>.



in-line shaft retainers
(cut vinyl tubing)

The small red pulley is the driven pulley. You may need to sand the dowel to slide the pulley on in a **tight** fit. (If the pulley is too loose, put a **small** piece of masking tape on the dowel and jam the pulley onto that; or use a glue gun.)





Mounting the Motor: Put the small black motor pulley onto the motor shaft. Catch the elastic band around the driven pulley on the axle, and the motor pulley. Pull to a very **easy** tension. The elastic band must not be too tight; but not so loose that it turns without turning the driven pulley. Make sure of the position of the motor mount before taking the protective film off the sticky-back. You can also stretch the elastic band afterwards.

Mounting the Solar Panel: Bend the metal strip attached to the back of the panel, and position it so that the bottom lip of the panel rests on the wood block. Use the paper fastener to attach the strip to the body. See illustration on front page.

Trouble-shooting: Is the panel pointing **towards the sun**? Check to see that the **elastic band** is not too tight...it must be fairly loose. Check to see that all **wire connections** are tight. Check to see that both axles are **free-wheeling**...axle spacers should not be tight up against the screw eyes. Is there **friction** anywhere else?

Something Neat: It will happen that a car will run into the shade and stop (no direct light, no electricity). Try reflecting light onto the solar panel with a mirror or two. Light is energy. What would happen if you had a whole bunch of mirrors reflecting light-energy to one spot?

Other Ideas: It is not necessary to use the supplied coroplast as a body...screw eyes will go into other recyclable materials, including blister packs, to make cars with different bodies. Too, a piece of tubing can be attached to one end of the motor pulley, and a dowel. Angled, the dowel beating against something will make a primitive **sun-drum**.

If you are holding this device loosely in your upturned palm,with the solar panel pointing toward the sun, it will vibrate. Consider that the panel is only about 1/8 efficient. If it were 100% efficient, you would only need a panel 1/8 this size to produce the energy you feel in your hand. That is to say, the energy you feel in your hand is what is in a postage stamp size of sunlight.