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Activity 4: Rookie Solar Racer

Introduction

Solar Energy refers to energy from the Sun that reaches the Earth. The energy primarily reaches us in the form of Visible Light, Infrared Light, and Ultraviolet Light. Solar Energy can be converted into Thermal Energy and Electrical Energy. Perhaps you have visited a swimming pool that has a solar cover. These covers are meant to convert Solar Energy into Thermal Energy in the pool water to increase the temperature of the water. See **Fig. 1**. Homes in sunny regions sometimes have special solar collectors that help to heat the house's water supply.

Fig. 1 These *Solar Sun Rings* are designed to convert Solar Energy from the Sun into Thermal Energy of the swimming pool water. Image from Leslie's Swimming Pool Supplies, http://www.lesliespool.com/.

Photovoltaic (PV) panels can convert Solar Energy directly into Electrical Energy. These panels are traditionally made from Silicon but are now made from other materials that exhibit the photoelectric effect. The photoelectric effect occurs when the energy from light causes an atom in a solid to emit an electron. If enough atoms are emitting enough electrons, Electrical Energy can be harvested. **Fig. 2** shows a typical residential solar photovoltaic panel.

Fig. 2 A typical rooftop arrangement of solar photovoltaic panels. Image from Advanced Energy Industries, http:// www.vaadvancedenergy.org/.

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Energy Efficiency and Conservation

In addition to making more energy in power plants, there are two other ways to help meet our country's energy demands: energy efficiency and energy conservation. Energy efficiency refers to using less energy to provide the same service. For example, the three main types of light bulbs are LEDs (Light Emitting Diode), CFLs (Compact Fluorescent Lamp, and incandescent bulbs. Each bulb can provide the same amount of light but each uses a different amount of electrical energy. **Table 1** provides a comparison of the three bulbs. When comparing the input power to the bulb, it can be seen that an incandescent bulb is inefficient and an LED bulb is the most efficient.

Type of Bulb	Power (Watts)	Light Output (lumens)
Light Emitting Diode	9-13	1100
Compact Fluorescent Lamp	18-25	1100
Incandescent Bulb	75	1100

Table 1 (data from http://www.designrecycleinc.com/led%20comp%20chart.html)

Energy conservation refers to reducing energy consumption by having less energy service. For instance, even if using an LED bulb, it is wasteful to leave a lamp on if you aren't using it.

Objective: Construct a solar powered racer and investigate how it works

Virginia SOLs: PS.1b, PS.1d, PS.1k, PS.1m, PS.2f, PS.5c, PS.6b, PS.6c, PS.7a, 3.1h, 3.1j, 6.1c, 6.1h, 6.2e

Suitable for students in grades 6-12

Materials:

- Screwdriver
- Lamp
- Long Nose Pliers
- Rookie Solar Racer Material List (See Fig. 3)

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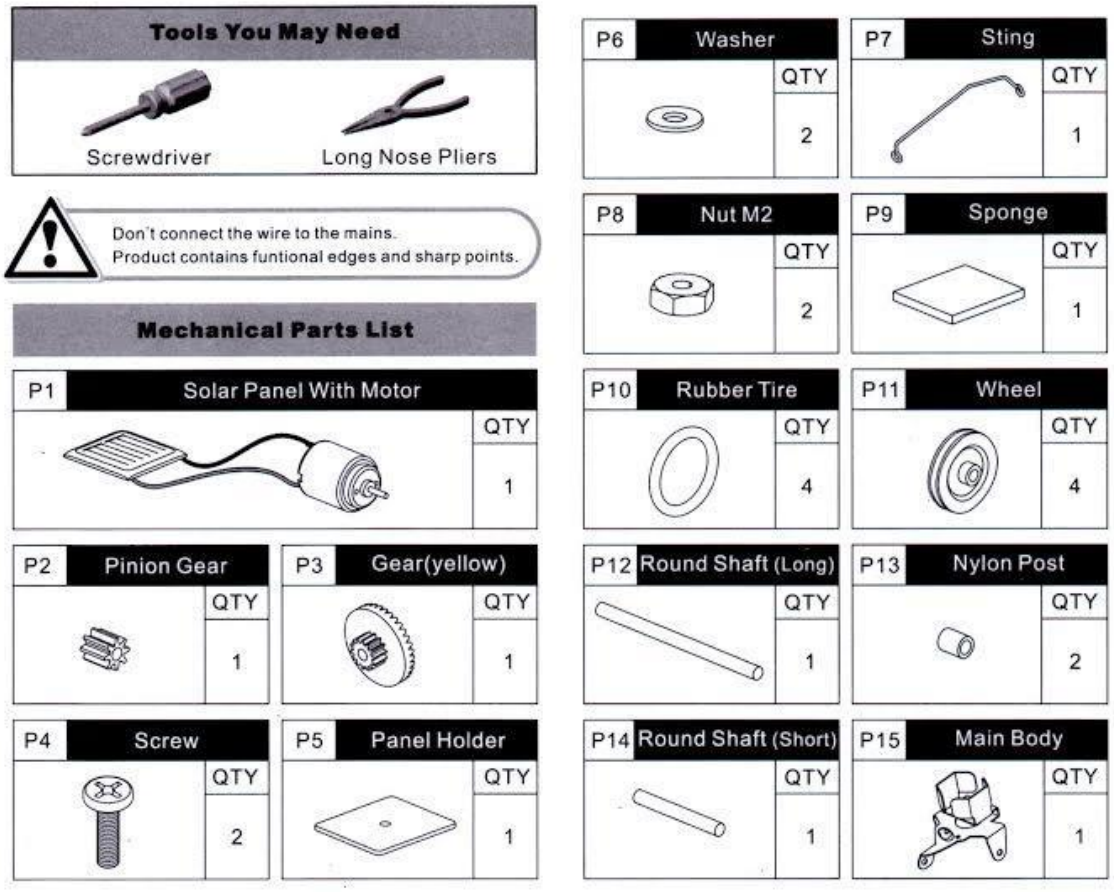

Fig. 3 Material list for the Rookie Solar Racer Kit

Prediction

1. Predict the behavior of the solar powered racer when one puts it outside in the sunlight. How about when one puts it under regular indoor lights?

_____
_____
_____

2. Can heat be used to power the racer? If the racer was put up to a heat lamp instead of a regular lamp, would the racer move?

_____
_____
_____

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Observation and Procedure

1. Attach the Pinion Gear to the metal bar on the Motor. Do so by setting the pinion gear down on a flat surface and then putting the metal bar inside. Make sure that the end of the pinion gear is flush with the end of the metal bar. See **Fig. 4**

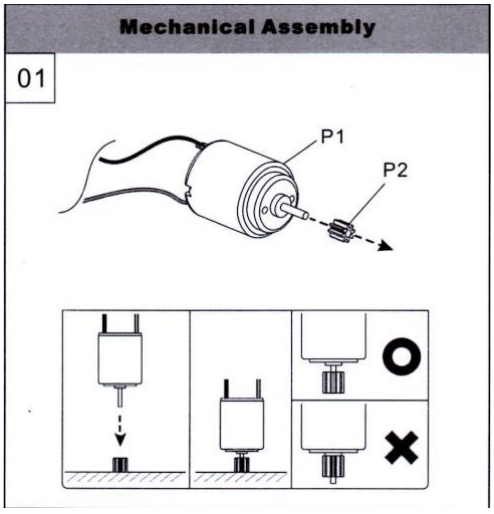

Fig. 4

2. Now put the solar panel with motor so that it is secure in the main body, with the wires and solar panel free. Press it down so that the main body is holding onto the motor firmly. See **Fig. 5**

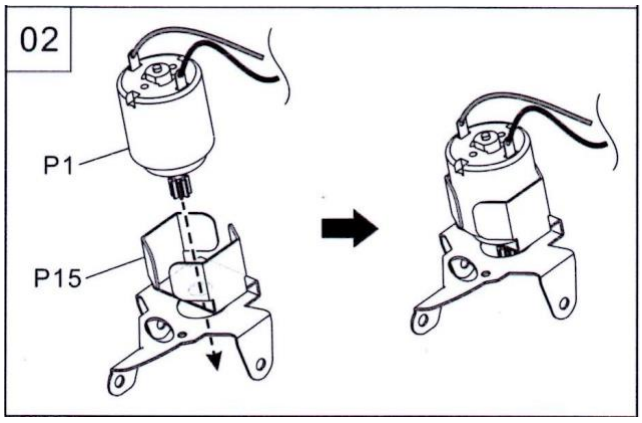

Fig. 5

3. Arrange the screw, panel holder, washer, sting, and bolt as shown in **Fig. 6** Use your screwdriver and long nose pliers to carefully tighten the screw and nut. Then attach the sponge onto the top of the panel holder and then stick the solar panel on top of that. Remember to remove the plastic that adheres to the sponge.

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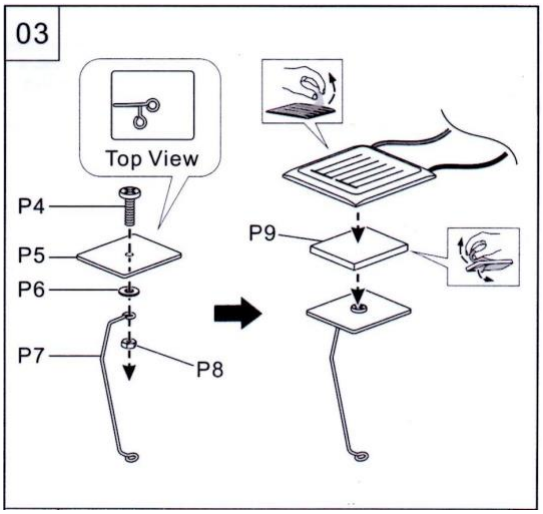

Fig. 6

4. Now, attach the sting to the base using a screw, washer, and nut. See **Fig. 7**

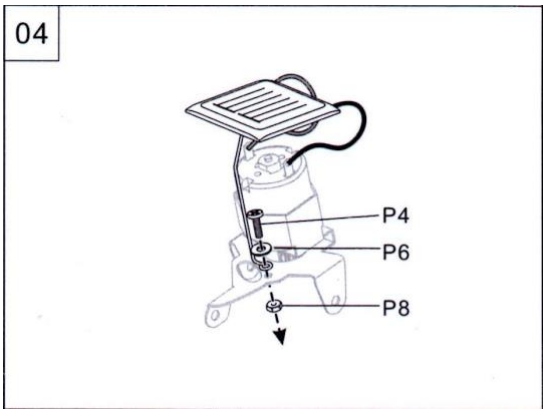

Fig. 7

5. Attach the two back wheels to the racer. First add the rubber circles to the wheels and then put the gear onto the long round shaft. Put the round shaft through the two holes with the gear in the middle and make sure the gear is touching the pinion gear and that it is not too loose or too tight. Then attach the wheels on either end with a 1mm clearance. See **Fig. 8.** What would happen if the wheels were attached too tightly?

_____

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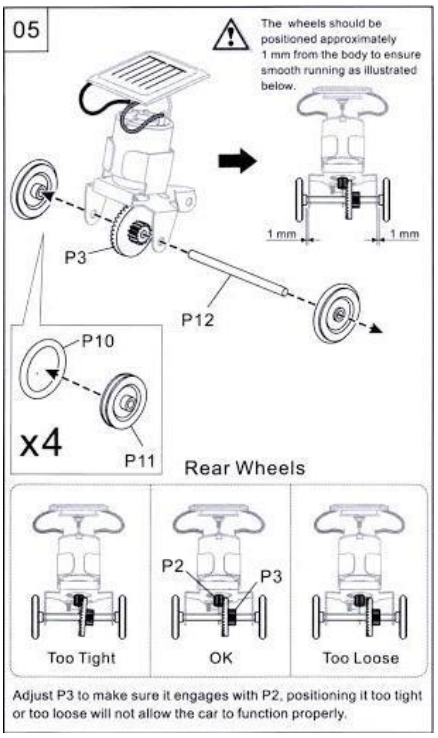

Fig. 8

6. Attach the two front wheels, again leaving a 1mm clearance between the wheels and the mount. See **Fig. 9**

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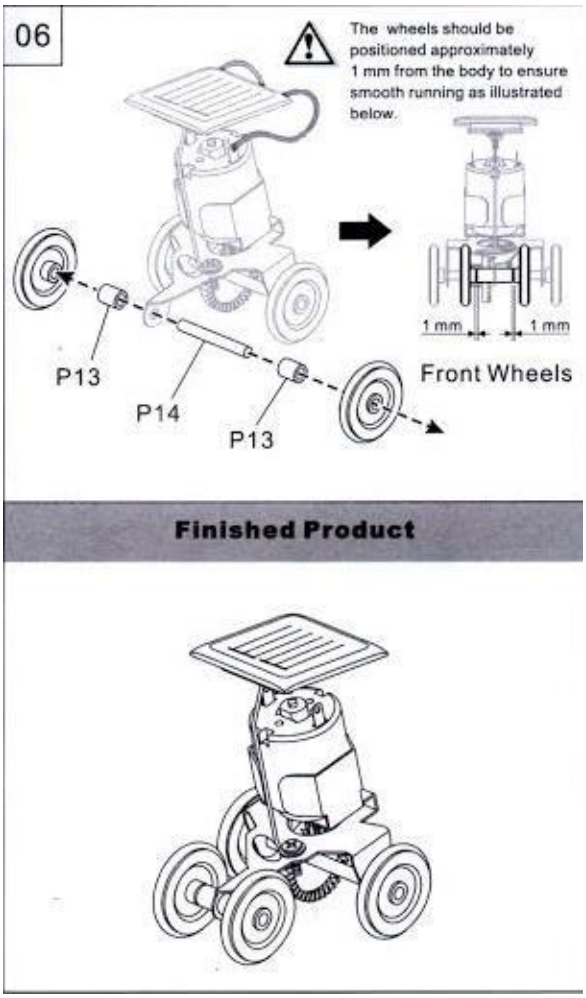

Fig. 9 The finished solar racer

Explain

1. Does the speed of the racer depend on the brightness of the light. How could you test this idea?

_____
_____
_____
_____
_____

2. Why couldn't you use a red or green laser pointer to get the solar car to move?

_____
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3. Does the speed of the racer depend on the wavelength of light? How could you test it?

_____
_____
_____

4. What are the ways in which energy is transferred that make the racer move?

_____
_____
_____

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