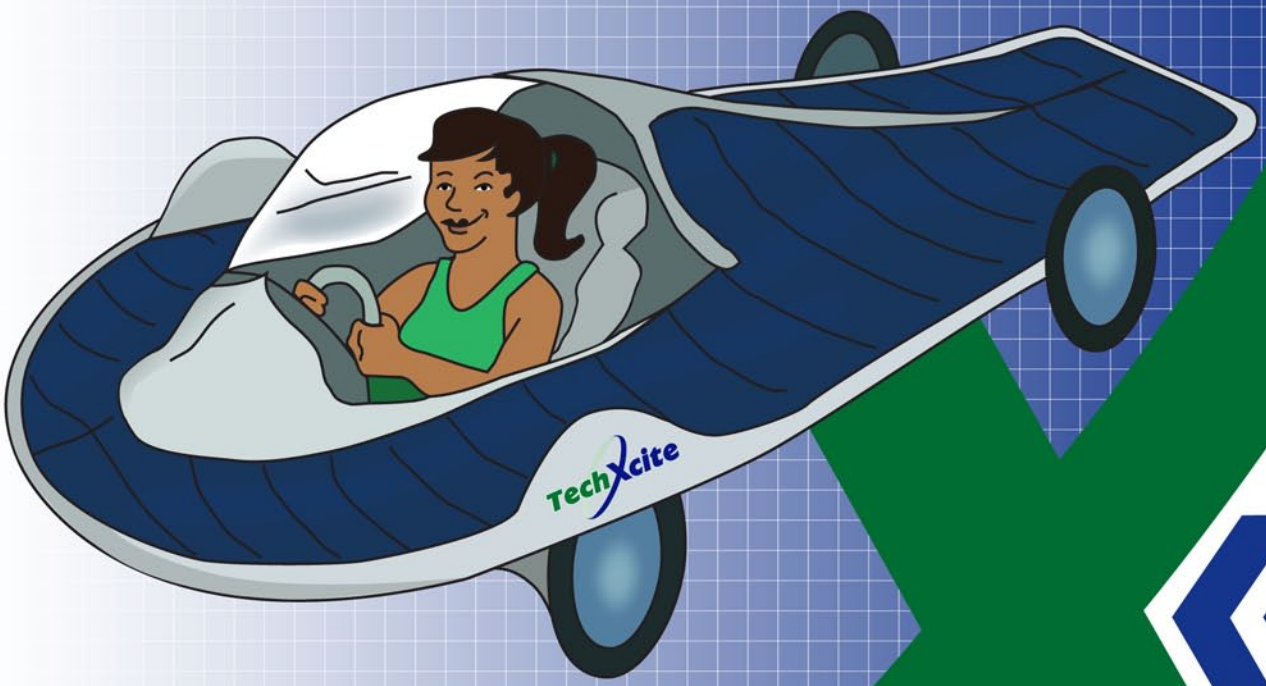


Racing with the Sun

TechXcite Discover Engineering

Youth Handouts

Activity 1: What Does a Solar Panel Do?

Name: _____ Date: _____

Materials List

- Solar panel
- Digital multimeter
- Motor
- AA battery
- 2 Alligator clip leads

Procedure

1. Turn the dial of the multimeter until it points to 20 VDC (or 20V---). In this position, up to 20 volts (DC) can be measured.
2. Measure the voltage across the AA battery by touching the red probe of the multimeter to the positive (+) terminal of the battery and the black probe to the negative (-) terminal of the battery. Make sure the probes are held firmly against the battery terminals to get a stable reading of the voltage. Record the voltage displayed on the multimeter in the table provided below.
3. Measure the battery again, this time with the black probe on the positive terminal and the red probe on the negative terminal. What changed?
4. Connect the battery to the motor using the alligator clip leads to make sure the motor works.
5. Now use the multimeter to measure and record solar panel voltage for three different lighting conditions: darkness, bright indoor lighting, and sunlight.

	Voltage
Battery	
Solar Panel: Darkness	
Solar Panel: Indoor Light	
Solar Panel: Sunlight	

6. Let's do a quick experiment! How much light do you think you'll need to power the motor?

   Connect your motor to the solar panel by clipping the solar panel leads onto the motor's terminals. Be sure the positive and negative solar panel alligator clips don't accidentally touch each other while connected to the motor terminals. That would create a short circuit causing the electric current to bypass the motor and go straight back to the solar panel without being used. A short circuit won't hurt this small solar panel, but it would cause major problems if it happened on a battery or a more powerful source of electricity.

   Test the 3 lighting conditions in your table and find out which ones, if any, have enough voltage output to run your motor.

Activity 1: What Does a Solar Panel Do?

Exploration Questions

1. What factors affected the voltage output from your solar panel?

2. What are some advantages of solar energy?

3. What are some disadvantages of solar energy?

Activity 2: Multiple Solar Panels

Name: _____ Date: _____

Materials List

- 2 Solar panels
- Digital multimeter
- Motor
- 2 AA batteries
- 4 Alligator clip leads

Procedure

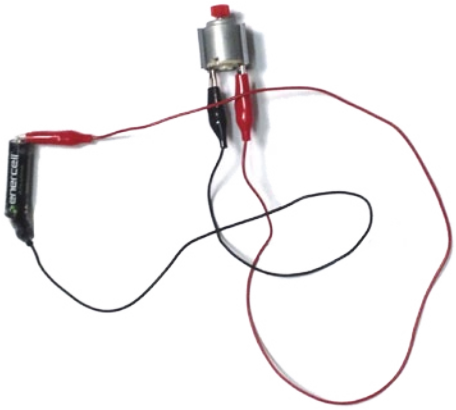
1. There is more than one way to connect multiple solar panels together. How do you think you would connect them in order to increase their total voltage? Try connecting the panels in at least two different ways and draw how you connected them in the spaces provided below. Measure and record the voltage of each.

Voltage: _____ Voltage: _____

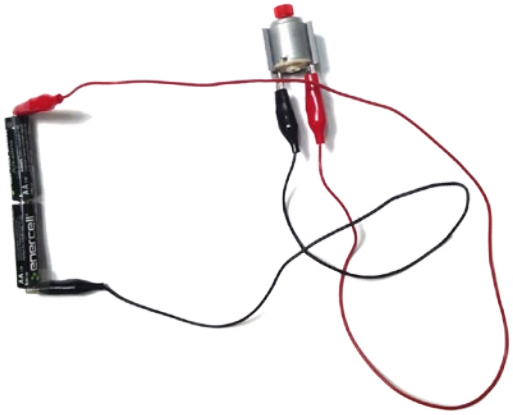
2. When you connect the panels together and their total voltage is the sum of the voltage generated by each individual panel, the panels form a *series* connection. In comparison, the voltage measured across panels connected in *parallel* remains the same and the current increases instead.

   If you haven't already, connect the motor to the solar panels in both series and parallel and make a note of the difference

Activity 2: Multiple Solar Panels



Motor connected to a single battery



Motor connected to two batteries in series

3. Now connect the batteries in series, as you did with the solar panels, and measure the combined voltage across the batteries with the multimeter. How does the voltage across one battery compare to the voltage across two batteries in series? How about when the batteries are in parallel?
4. Test the motor with the batteries connected in series and in parallel. You may need to use tape to secure the wires to the batteries.

Exploration Questions

1. How did the number of solar panels connected in series affect voltage?

2. How did the motor react when it was connected to multiple solar panels? Multiple batteries?

Activity 3: Building a Solar Car

Name: _____ Date: _____

Materials List

- Masking tape
- SolGear solar car kit:
  - Solar panel
  - Motor
  - Plastic motor mount
  - 4 Wheels
  - 4 Rubber tires
  - 4 Eyelets
  - Small gear
  - Large gear
  - 2 Wooden dowels
  - Plastic tubing
  - 2 Square wooden sticks
  - SolGear instructions

Engineering Design Challenge

Your challenge is to build a car that will move as fast as possible over a flat surface using only power from the sun. The SolGear instructions will provide a starting point for designing the car.

Exploration Questions

1. Describe your design process. What factors did you consider when constructing your solar car?

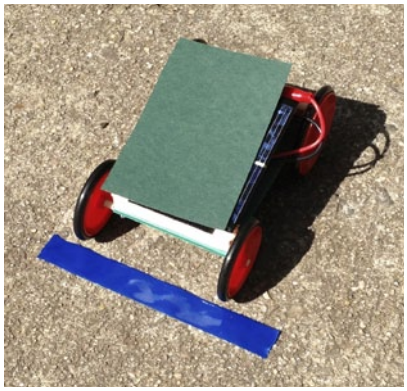
2. How should we evaluate the performance of the cars? What conditions must we consider when testing them?

Activity 4: Mini Solar Challenge

Name: _____ Date: _____

Materials List

- Solar car (Built in Activity 3)
- Sun blocker (File folder, book, etc.)



Procedure

1. Examine your solar car to make sure it is ready to be raced. Check:
    - Solar panel has not been cracked or damaged
    - All components (solar panel, motor, wheels and axles) are securely attached to the chassis
    - Wheels and axles don't slide from side to side
    - Motor and solar panel are connected
2. As a class, you'll determine how you want to conduct the race and make the necessary preparations.
3. Decide with your partner which one of you will hold the car at the starting line and who will wait at the finish line to catch the car.
4. Once your car is in position at the starting line, make sure the solar panels are secure and pointing toward the sun. When the start signal is given, remove the sun blocker from the solar panels to power the car.
5. Record the length of the racecourse (distance from starting line to finish line) and your race time:

    Length of the racecourse: _____

    Race time of your solar car: _____

    Race time of *fastest* solar car: _____
6. After the race is completed, make any necessary changes to your solar car to help it go faster.

Activity 4: Mini Solar Challenge

Exploration Questions

1. What are some advantages of a solar-powered car compared to a car with an internal combustion engine?

2. What are some obstacles we would need to overcome to make solar cars more practical? Brainstorm some possible solutions to these problems.

3. How did you conduct your race? How might you change the racing procedure?

4. Did your solar car move as fast as you thought it would? What changes would you make to increase its performance?