Activity 3: Mini Solar Challenge

Time Required: 45 minutes

Materials List

Group Size: 2 students per group (same groups as in Activity 2)
Each group needs:
- Solar Car (built in Activity 2)
- Opaque Material (i.e. file folder, book, etc.)

For the class:
- 2 Stop Watches
- Tape Measure
- Chalk

Youth Worksheets
Race a Solar Car Worksheet

Learning Objectives

After this activity, students should be able to:
- Design and build an electric car which has a motor that is connected to a solar panel.
- Identify factors that affect the performance of a solar car including friction, position of the axles, and weight of the car.
- Design an experiment to test the performance of a solar car.

Introduction:

As mentioned in the last activity, teams of college students participate in national and international competitions each year in which cars powered entirely by solar power race hundreds of miles. The two main competitions are the American Solar Challenge <http://americansolarchallenge.org/> and the World Solar Challenge <http://www.wsc.org.au/>. Now, you will have the opportunity to participate in a mini-solar challenge.

This activity gives you the opportunity to test the solar cars you built in Activity 2. Test Engineers have an important role in testing devices to see if they are ready for production and sale. They must first establish test procedures that ensure the product is safe, performs within specifications, and is durable. They must conduct the tests and then present the results with any recommendations for changes.

Last time, we finished by discussing how we might test the solar cars. What were some of the ideas you had and can we come up with a few more? [Answers: Race them against each other. Time them over a known distance]

What are some other things we might consider when testing the cars? [Answers: Is the sunlight constant? Is there a slope?, etc.]

[Based on the students ideas, possibly through a vote, select a method for testing the solar cars.]
Procedure

Before the Activity: 15 Minutes

1) Verify that you have a clear, sunny day. This activity is weather dependent. If it is raining or overcast, postpone this activity. If there are just some clouds in the sky, it will likely still work. It is important to have a backup plan when testing solar cars.

2) Locate a testing area. This area should have a hard surface that is fairly flat. For example, a sidewalk, empty basketball court, or empty parking lot would work well as testing areas.

3) Obtain some file folders, books, magazines, or blank pieces of paper. One for each car will provide the students a way to block the sunlight from their solar panels to keep their cars from moving before the race begins.

During the Activity:

1) Split the students into the same pairs as in the last Activity.

2) Provide each group with the activity sheet (Race a Solar Car Worksheet).

3) Have the students first examine their solar car to make sure it is ready to be raced. Often a few last minute adjustments will be required for some students. Students should verify that:
   a. The solar panel has not been cracked or damaged.
   b. All components (the solar panel, motor, wheels, and axles) are securely attached to their chassis. They should check their wheels and axles to insure that they will not slide from side to side.
   c. The motor and solar panel are connected.

4) Discuss with the students how they want to race their cars. The students should brainstorm different ideas, such as each car races independently (so individual race times are just compared at the end of the race), two cars race together, or all cars race at one time (this is a difficult method because there are only two stop watches).

5) Have the students take their solar cars outside to the location you have designated as the testing area.

6) Have the students mark the start line and finish line with chalk (The distance between the start line and finish line can be whatever the students decide, but 20-40 feet should work well). The students should measure the distance between the start line and finish line with the tape measure and record this distance on their worksheet.

7) Have the students cover the solar panel on their solar car with an opaque material (such as a file folder) to allow the students to set their solar cars at the start line. The students should verify that their solar panel is pointing towards the sun and that the panel is steady.

8) Have one of the students from the pair stand with solar car at the start line and the other student stand at the finish line so she/he can catch the solar car.

9) When the timers are ready (two students should act as timers for each race) give the official signal and have the students remove the opaque paper covering the solar cell to start the race. As students are setting up the experiment, they may consider having the same two students time each race in order to provide consistent results. This can be left up to the class as they design their experiment.

10) During the race students should not touch the solar car.
11) Have the students record their times on their worksheet.
12) After each car has raced, give the groups a few minutes to make changes to their cars to see how they can make their cars go faster. For example, students may reposition the angle of their solar panel or find ways to reduce friction between the wheels and the axles.

**Processing and Activity Closure:**
Just as on the first day, ask the students, “What are some of the advantages of a solar powered car as compared to a regular car?” [Possible Answers: quieter, renewable energy, does not use gas]

“What do you think are some problems that would need to be overcome to make a solar car work?” [Possible Answers: driving at night, driving when it is cloudy, solar panels only provide enough power for small vehicles]

[Whatever the students come up with, ask them to brainstorm possible solutions to these problems.]

If students in your program would like it participate in a regional solar car competition you may want to structure this racing activity to match the rules of the regional race. Please visit the NC Solar Center website (http://www.evchallenge.org/schools/middleschool/index.html) before beginning this activity for background information, rules, and an application.

**Additional Instructor Resources:**

Resources about Junior Solar Sprint competitions:
http://www.nrel.gov/education/jss_hfc.html
http://www.nrel.gov/education/rules_regulations.html
http://www.evchallenge.org/schools/middleschool/index.html

**Embedded Assessment**
Please collect and copy page 25 of the student handout.

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Engineering Activity – Race a Solar Car Worksheet

Name: ___________________________________

Date: __________________________

In this activity you are going to use engineering testing principles to test a solar powered car. Specifically, you will be using the solar car you built in Activity 2 to race with your friends. Additionally, you will be examining different factors that affect the performance (racing ability) of your solar car.

Materials List
- Solar Car (built in Activity 2)
- Opaque Material (i.e. file folder, book, etc.)

Rules
- Do not lose any of the parts. These parts will be used by future classes.
- Do not bend, drop, or damage your solar panel. Cracks and damage to the solar panel will reduce the efficiency of your panel. Your solar car will not be able to go as fast when you are racing it if the solar panel is damaged.

Procedure
1) Examine your solar car to make sure it is ready to be raced.
2) Determine how you want to conduct the race.
3) Take your solar car to the test site.
4) Have one member of your team hold your solar car at the start line while covering the solar panel with an opaque material. This team member removes this opaque material when the signal is given to start the race.
5) The other member of the team should be at the finish line ready to catch your solar car.
6) Record the length of the race course (distance measured between the starting line and finish line) and the race time of your solar car in the table below.
7) After the race is completed make changes to your solar car to see how you can make your car go faster.
8) After the testing is complete, remove the solar panel and return it to your instructor.
| Length of Race Course (distance measured from starting line to finish line) |  |
| Race Time of your Solar Car |  |
| Race Time of Fastest Solar Car |  |

**Exploration Questions:**
How did you conduct your race? How would you change the racing procedure?

What factors affected the performance of your car in this activity? How are these different than those predicted in Activity 2?

Did your solar car move as fast as you thought it would? What changes would you make to your solar car to make it race faster and perform better?