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Quick View

Students design a solar vehicle to complete a 20-meter racecourse at the fastest speed possible.

Standards Addressed

NSTA 5-8
Students develop abilities necessary to do scientific inquiry.

- Students use appropriate tools and techniques to gather, analyze, and interpret data.
- Students think critically and logically to make the relationships between evidence and explanations.
- Students communicate scientific procedures and explanations.
- Students use mathematics in all aspects of scientific inquiry.

Students develop abilities for technological design.

- Students identify appropriate problems for technological design.
- Students design a solution or product.
- Students implement a proposed design.
- Students evaluate completed technological designs or products.

NCTM 6-8
Students understand measurable attributes of objects and the units, systems, and processes of measurement.

- Students understand both metric and customary systems of measurement.

Students formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

- Students formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population.

Students solve problems that arise in mathematics and in other contexts.

Students recognize and apply mathematics in contexts outside of mathematics.

ITEA 6-9
Students develop abilities to assess the impact of products and systems.

- Students learn to design and use instruments to gather data.

Students develop the abilities to apply the design process.

- Students learn to apply a design process to solve problems in and beyond the laboratory-classroom.
- Students learn to specify criteria and constraints for the design.
- Students learn to make two-dimensional and three-dimensional representations of the designed solution.
- Students learn to test and evaluate the design in relation to pre-establish requirements, such as criteria and constraints, and refine as needed.
- Students learn to make a product or system and document the solution.

Students develop an understanding of engineering design.

- Students learn that modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

Students develop an understanding of the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.

- Students learn that some technological problems are best solved through experimentation.

Time Required

360-730 minutes (will vary with class size)

Content Areas

Primary: Engineering, technology
Secondary: Math, science, language arts

Vocabulary

- constraint
- specification
- speed
- velocity

Materials

- Solar vehicle kits or components necessary to build a solar vehicle
- Cool-melt glue gun
- Cool-melt glue slugs
- Utility knife or coping saw
- Measuring tape
- Stopwatch
- "Engineering for Speed" worksheet
- "Lab Report Template" (optional)

Procedure

1 After building and testing a solar vehicle following the kit instructions, think about the characteristics of a fast vehicle. Consider what design specifications could be changed to make the car move at a higher speed. List these on the "Engineering for Speed" worksheet.

You may want to discuss with students what the term "specification" refers to and what design specifications may affect the vehicle's speed. The worksheet lists the number of wheels as an example of a specification that could be changed. Students may or may not feel that the number of wheels has anything to do with the vehicle's speed. You may want to discuss this as a class before students make their list or you may feel that letting students brainstorm for a few minutes before discussion would better suit your needs.

2 Design a solar vehicle to travel a 20-meter racetrack at the highest speed possible. You must use a standard motor and only one solar panel. All other design specifications are open to modification. Sketch your design on a sheet of graph paper.

Students will need access to a racetrack that is flat and of sufficient length. Twenty meters is the length of the course in the Junior Solar Sprint Competition, but you may use a shorter track if space is limited.

Students can use another kit and modify the pieces to meet their design. You may also provide scraps of balsa wood or other items for students to use in constructing their vehicles.

3 Discuss your design with your instructor. Take into consideration any design changes he or she suggests. Adjust your design if necessary.

Take this opportunity to ask students why they made the design choices they made. You should point out potential problems – weak chassis, clearance issues, panel attachment, and so forth – to students.

4 Build your vehicle.

5 Test your vehicle on the 20-meter racetrack. Record time and distance traveled on your worksheet.

6 Speed is equal to the distance traveled divided by the time necessary to travel that distance. Record the speed at which your vehicle traveled on your worksheet.

You may want to practice a few calculations with students before they begin to find their own speeds. You may also want to go over with students the difference between speed and velocity. Point out to students that although the calculation is the same for both values, velocity is speed in a specific direction.

7 Evaluate your test results. Are there minor adjustments you could make to increase the speed of your vehicle? Revisit the list of design specifications you created in Step 1. Can you make changes to these items to increase speed?

8 Make modifications to your vehicle. Record these modifications on your worksheet. You may list them, write a short paragraph to explain them, or draw a sketch to show them.

9 Retest your vehicle. Record your test results on your worksheet or use computer software to create a spreadsheet to track your results.

10 Compare results between the two tests. Are there still design changes you could make to reach a maximum speed?

11 Repeat the process of redesigning and retesting your vehicle as many times as necessary (or until your instructor stops you) to achieve the maximum speed.

12 Write a report explaining the design, test, redesign, and retest process that you used to complete this activity. Include your design specifications, constraints, design sketches, test results, and conclusions.

Students may want to use the "Lab Report Template" provided in the resource section of this guide or you may choose to have them use a different format for reporting their results.

Quick View

Design a solar vehicle to complete a 20-meter racecourse at the fastest speed possible.

Materials

- Solar vehicle kits or components necessary to build a solar vehicle
- Cool-melt glue gun
- Cool-melt glue slugs
- Utility knife or coping saw
- Measuring tape
- Stopwatch
- "Engineering for Speed" worksheet
- "Lab Report Template" (optional)

Procedure

1 After building and testing a solar vehicle following the kit's instructions, think about the characteristics of a fast vehicle. Consider what design specifications could be changed to make the car move at a higher speed. List these on the "Engineering for Speed" worksheet.

2 Design a solar vehicle to travel a 20-meter racetrack at the highest speed possible. You must use a standard motor and only one solar panel. All other design specifications are open to modification. Sketch your design on a sheet of graph paper.

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10 Compare results between the two tests. Are there still design changes you could make to reach a maximum speed?

11 Repeat the process of redesigning and retesting your vehicle as many times as necessary (or until your instructor stops you) to achieve the maximum speed.

12 Write a report explaining the design, test, redesign, and retest process that you used to complete this activity. Include your design specifications, constraints, design sketches, test results, and conclusions.

Engineering for Speed

List the specifications of the solar vehicle's design that can be changed. Specifically, think about specifications that affect the vehicle's speed. For example, the number of wheels can be changed, but do you think this would affect the speed of the vehicle?

Attach your design sketch or create a thumbnail sketch of your proposed design.

Record your test results for each design.

Design Number	Test Number	Distance Traveled (m)	Time (s)	Speed (m/s)

List the modifications you made to the original design. Explain why you made each modification. It is very important that you keep track of the changes and the reasons for each change. This gives you the opportunity to revisit your ideas. You may find that something you tried in a previous design may work with a change from a later design.

List the modification you made to the design. Explain why you made each modification. (Complete this step each time you redesign the vehicle.)