Solar Boats

Lesson 8: Collect Data & Compare Performance of Different Boat Designs

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DESCRIPTION: Students will race the solar speedboats, airboats, and surface submarines and then compare the performance results and of the various types of solar boats made by the class. Students will compare and contrast forces acting on the system by examining the results of the airboat, speedboat and surface submarine races.

GRADE LEVEL(S): 4, 5, 6

SUBJECT AREA(S): Science, energy, electricity, data collection, analysis, force, buoyancy, gravity, variables, motion, acceleration

ACTIVITY LENGTH: 1 hour

LEARNING GOAL(S):
Students will compare and contrast forces acting on the system by examining the results of the airboat, speedboat and surface submarine races. Students will collect quantitative and qualitative data points that denote the effectiveness of each boat design. Students will compare observations made during the race and draw conclusions from these observations.

NEXT GENERATION SCIENCE STANDARDS:

- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3.Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- PS2-1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

- PS2- 2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

STUDENT BACKGROUND:
Students have a basic understanding of types of energy and energy transfer and transformation. They should understand that light hitting a solar panel generates electricity.

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Materials List (30-person class)

- Solar vehicles, created in Lesson 7
- Box and T-Chart printouts
- Stopwatches
- Pool/Racetrack with at least 4-6 inches of water – you don't need much water; see associated sketch for solar boat race track
- Sunny day or light fixtures to activate solar cells.
- ***Safety Note: Light fixtures and water can be dangerous! Please use proper precautions. (The boats themselves use very little electricity, and that the lights are more of a concern.)***

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Lesson Details

Activity – Solar Boat Races

Your teams should be prepared for testing from the last activities. This day will start with the outdoor races. Ensure that your students have proper means by which to record race outcomes, or select a designated timekeeper/record keeper for this data.

First Race: (like water vehicles)
- Student Teams of solar speedboats can race each other (3 teams).
- Student Teams of solar airboats can race each other (3 teams).
- Student Teams of solar surface submarines can race each other (3 teams).

Another Race: (different water vehicles)
- Student Teams (one solar speed boat, one surface submarine, and one air boat) can race each other.

Future Race: (water vehicle versus a land vehicle: solar car)
- Student Teams (solar speed boats vs. solar cars)
- Student Teams (solar air boats vs. solar cars)
- Student Teams (solar surface submarines vs. solar cars)

Gather back in the classroom and pass out Box and T Charts for students to quickly compare results while fresh in their minds. More specifically, students will be comparing the results of each of the cars in the race, i.e. speedboat v. airboat, submarine v. airboat etc. Be sure to discuss selecting specific quantitative and qualitative variables to compare with them (quantitative example being time to finish the race and qualitative being ability to move in a straight line).

Since these variables will be discussed more fully next lesson, having students nail down vocabulary is not necessarily important, however, pushing them to analyze different types of data is the goal and they will later identify the type in the next lesson.

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