Charged Cars - Math in Motion

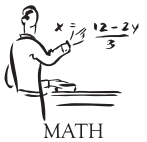
This project has been wonderful! The experience of designing, building, and adjusting a precision vehicle that must be mathematically accurate has given students a chance to see the beauty that a combination of ingenuity and mathematics can bring to their creations. I had kids filling my lab during lunch, arriving early to class, and asking to stay after to work on their cars and refine their data. Any time that I see students volunteering to come in to practice math, I know that I have succeeded as a teacher.

7-9

GRADE LEVEL

ARTS

LANGUAGE



MATH

Misc

MISCELLANEOUS

SCIENCE

HISTORY

SOCIAL STUDIES

15-20

CLASSES

$1000

TOTAL BUDGET

Curriculum/State Standard

The Alaska State Standards are located on the Web at www.eed.state.ak.us

Mathematics - measurement, estimation, computation, geometry, statistics, problem solving, and communication.

Science - energy transfer, electricity, inquiry, experimentation.

Employability - work ethic, application of skills and academic knowledge in a variety of settings, safe practices.

Overview

Students must design and build a battery-operated vehicle that has a wheelbase of 40 cm and is adjustable to travel and stop at any designated point between 1 and 10 meters. The final products are tested on a 10 m straight track. Each "team" receives two designated stopping distances immediately before their runs and must adjust their cars on the spot.

Continued ...

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Foundation for Educational Excellence

Kids In Need

THIS WINNING LESSON PLAN WAS SUBMITTED BY:

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"Charged Cars - Math in Motion" project continued...

Objectives

- The student will design, build, and refine a battery-operated vehicle that includes a simple electrical circuit, an on/off switch, a small motor, gears, axles and a braking system. The car will travel a straight line and stop at a line that is 10 meters from the starting point.
- The student will apply ratios to the gearing to control speed, and use proportions to determine the number of wheel rotations necessary for the vehicle to travel designated distances between 1 and 10 meters.
- The student will collect performance data and will use the data to predict the distance the vehicle will travel in various time periods, and be able to adjust the distance the car will travel.
- The student will learn about work ethic by meeting or exceeding employability standards for preparedness, initiative, productivity, punctuality, and respect as described on their scoring guides.
- The student will measure using the metric system, solder simple connections, and apply geometry to construct a symmetrical chassis.

Materials

1X4 lumber, gear box and motor kits, 1/8" brass axle rod, 5/32" brass tubing mini pressure switches, mini slide switches, 6"-8" foam wheels, 3" foam wheels*, gear box kits, battery boxes for "C" batteries, insulated fine wire, batteries, large wide rubber bands, graph paper (17X22), solder, gator clips, various glues, screws, ¼" all-thread rod, threaded connectors to fit the all-thread

**Hint: I made 6-8 inch wheels from blue board foam insulation with a hole saw for 17 cents each.*

Readiness Activity

First, the instructor must construct a vehicle that works so that the students will have an example. It is a humbling but rewarding experience! The basic idea is that the slide switch activates a motor. The motor turns the gears in the gearbox and the final gear meshes with a drive gear that is mounted on the 1/8-inch rear axle. Meanwhile, the front axle is made of all thread and the wheel is mounted on a threaded connector or a nut that travels along the all-thread as the wheel turns. When the wheel turns enough to travel all the way into the wood chassis, it hits a small lever switch that cuts off the power to the motor. This enables the designer to "set" the front wheel for various distances by turning it backwards various numbers of rotations.

Present the challenge to the students and show them an example of a working battery-operated vehicle that is adjustable to stop at distances between 1 and 10 m. Emphasize that the contest is for accuracy, not speed. One way to conserve materials is to give the students "checking accounts" (Pitsco Business Kit) that they must use to purchase materials at the classroom store. The challenge for the teacher is to figure out how much money they should initially "deposit" so that the kids will be frugal.

Give each team of two students graph paper and ask them to sketch a lifesize drawing of a chassis and axles. The team will add to the plans as they learn about the dimensions of the available materials, wiring, etc. The plans will serve as the basis for their construction, so the instructor will be able to advise and guide the students toward a successful project.

Strategies/Activities

Challenge: Introduce the students to the specifications for the vehicle, the scoring guides for assessing the objectives, and assign partners for the job's duration.

Brainstorm: Students discuss their ideas and define their needs in small groups and then present to the class. Schedules of lessons, skill workshops, experts to invite to class, and research times are created using student and teacher input. Ideas are shared and materials lists compiled.

Electricity workshops: Students learn electricity basics and create a simple circuit with a switch and motor.

Chassis design classes (include braking system design inquiry and gearing instruction: Students learn to create and check symmetry using geometric principles so that their vehicles will travel in a straight line, measure and cut wood chassis, attach axles, create or adapt wheels, mount circuits and battery boxes, install initial experimental braking systems, etc.

Vehicle testing and modification: Students will run their vehicles and refine their design and construction to meet the goals of producing a vehicle that will travel 10 m in a straight line and stop. Instruction includes ratios of wheel circumference to distance traveled, gear ratios to control vehicle speed. Students will share examples of success with the rest of the class. Sharing of ideas and techniques is encouraged.

Data Collection and line of best fit: Students will create a graph that compares time and distance traveled (up to 10 m) and use a line of best fit to predict their vehicles' distance traveled when given a specific time.

Continued ...

"Charged Cars - Math in Motion" project continued...

Culminating Activity

The kids have a competition during the final few class sessions. An official 10m X 1.5m track is laid out on the floor along with a metric tape to mark the distance the cars travel. The starting line is taped at "0" and the teacher chooses and tapes a finish line that is between 5 and 10 meters. A mark is made in the exact center of the finish line. Each student team must preset their car to travel from the start to the center of the finish line. Measuring the distance in centimeters from a specified point on the car to the mark on the finish line yields the score. The lowest scores "win". My class enjoys chances to draw from my Cheap and Stupid Prize Bucket which contains slips that are good for homework exemptions, candy, one-minute get out of class early passes, etc.

Evaluation

Scoring guides that specified four levels of performance ranging from deficient to exemplary were available before all student assessments. Students were able to clearly define the expectations for each type of assessment. Assessments included: performance assessment for workshop safety, construction skills, measurement, employability skills; product quality assessment (vehicle specifications and final performance, data and design portfolio) for meeting and/or exceeding minimum specifications as defined on the scoring guide; traditional tests for knowledge and application of skills for math and science.