Name(s)	Project Number
Conor Gard	**J1709**

Project Title

The Winning Position: How Changing the Center-of-Gravity in a Race Car Impacts Velocity

Abstract

Objectives
This project explored how changing the center-of-mass in a gravity powered model race car (pinewood derby car) affected its speed. My hypothesis was that the car would go faster the farther back the center of mass was in the car.

Methods
To test the hypothesis I modified a wooden track with a 25 degree incline, a 4 foot vertical drop, and overall length of 32 feet. The modifications included a computer controlled solenoid starting gate and a laser diode timing gate at the finish line. I designed and 3-D printed a car that had a longer wheelbase than a standard pinewood derby car but kept the overall length consistent at 7 inches. The center-of-mass could be changed to different locations using 50 gram weights that were held in place with a threaded screw. The longer wheelbase was to compensate for the weight which when positioned very far back in a standard car s wheelbase, causes the front of the car to wobble (and loose speed).

Results
The car was raced 10 times in each of the 5 center-of-mass locations to get an average speed and standard deviation. The results were graphed to show the center of mass in inches (as measured from the front of the car) versus finish time (mS). The graph shows the average finish time and the standard deviation. The fastest average finish time was 2538.6 +/- 5.2 mS when the center of mass was in the far back of the car. The slowest time was 2571.5 +/- 13.1 mS which was measured when the center of mass was in the far front of the car.

Conclusions
The results confirmed my hypothesis by demonstrating that the farther back you put the center-of-mass, the faster the car goes and these velocity differences were statistically significant.

Summary Statement

The center-of-mass in a gravity powered race car was systematically varied to determine the position that produced the highest velocity; this was determined to be as far back in the race car as possible.

Help Received

My dad helped set up the track, helped with power tools, and showed me how to program in C++.