



# CALIFORNIA STATE SCIENCE FAIR 2002 PROJECT SUMMARY

<b>Name(s)</b> <b>Stephen Chu; Robert Paolini</b>	<b>Project Number</b> <b>J0209</b>
<b>Project Title</b> <b>Torque and Speed</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> What is the relationship between the torque and speed of a vehicle?</p> <p>Hypothesis: If gear ratio (input to final drive) values increase, then the speed of a vehicle will decrease and the torque will increase.</p> <p><b>Methods/Materials</b> Materials: Lego robot, ruler, spring scale, robot programmer, bicycle, car alternator, capacitors, power supplies, drive belt, meters, spring scale, light bulb. Method: A robot was constructed with changeable gear ratio and programmable control of its run time. Its speed and torque were measured for the different gear ratio values. Separately, a bicycle experimental apparatus using the above materials was built to investigate how torque and speed are used in real life. The rear wheel was connected to the alternator via the drive belt. An adjustable DC power supply was used to supply the field current (electromagnet) in the alternator. An opto-interrupter was used to detect the rotation of the alternator by connecting it to an oscilloscope. This setup allowed the alternator speed to be monitored as Hz. The voltage and current of the field winding (input) and stator winding (output) were also monitored. A spring scale was used to measure the static torque at the pedals over the range of field currents and gear ratios. For an electrical load on the output, a light bulb was used. Data was collected for input voltage and current, input torque, output voltage and current, gear selection, and alternator speed. Using a spreadsheet, calculations could be made using standard engineering formulas, like Ohms Law, to explore the entire range of operation of the bicycle apparatus.</p> <p><b>Results</b> The data for the robot showed that when the gear ratio value increased, the torque increased but the speed decreased. The relationship showed that the torque and speed were inversely proportional. The results for the bicycle showed that when the pedal to the generator ratio or the electromagnetic charge on the generator increased, the torque required to rotate the pedals increased. The data also showed that when the rpm or the electromagnetic charge on the generator increased, the amount of power produced also increased. Again the torque and speed had an inverse relationship.</p> <p><b>Conclusions/Discussion</b> Both the robot and bicycle supported our hypothesis, which was if the gear ratio values were increased, then the speed of a vehicle will decrease and the torque will increase. Generating electricity is hard work.</p>	
<b>Summary Statement</b> Our project is about finding the relationship between torque and speed and applying it to a real life example.	
<b>Help Received</b> Dad helped with the providing and supervision of tools, transportation, and mentoring for project planning. Moms helped with transportation, food, and proofreading the report.	