



**CALIFORNIA STATE SCIENCE FAIR  
2006 PROJECT SUMMARY**

<b>Name(s)</b> <b>Maliha S. Ahmed</b>	<b>Project Number</b> <b>S0201</b>
<b>Project Title</b> <b>Investigating Resonance and Analyzing the Effects of Tension in a Multi-Pendulum System</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of this project was to examine the properties of resonance and the effects of tension in multi-pendulum system. The independent variable was the amount of tension in the system and the dependent variable was the displacement of the pendulums. The collected data (1) showed the relative amounts of energy transfer during the oscillations at various tensions and (2) showed when resonance could be achieved. The hypothesis was that if the tension between the pendulums increases, less energy will transfer between the pendulums but resonance patterns will only be seen at lower tensions.</p> <p><b>Methods/Materials</b> Three pendulums were used to simulate a multi-pendulum system. Each pendulum was first built by attaching a 1-ounce fishing weight to a 14.5-inch fishing wire. These fishing wires were then placed equidistantly from one another on a longer fishing line (base string) that ran the entire length of a wooden bar. Hooks were attached to both ends of this base string. Predetermined weights were then added to these hooks (500 grams and 1 kg). Changing the weights changed the amount of tension in the base string, and thus, changed the amount of tension in the system. To simulate infinite tension in the base string, the pendulums were hung from hooks that were directly attached to the wooden bar. Ten combinations of released and non-released pendulums were examined at different tensions.</p> <p><b>Results</b> In almost every case, the oscillations of the released pendulum transferred energy to the non-released pendulums. This caused the non-released pendulums to start oscillating, which increased the number of oscillations in the system. In most situations, as the tension increased, less energy was transferred from the released pendulum to the non-released pendulums. When the base string tension was infinity, no energy was transferred.</p> <p><b>Conclusions/Discussion</b> When analyzing the non-released pendulums, there was less energy transfer with increasing tensions (proving the hypothesis correct). When analyzing the released pendulums, there was less energy transfer at infinite tension and the "Control + 10 Newton" tension (proving the hypothesis correct). However, at the "Control + 5 Newton" tension, there appeared to be greater energy transfer than at "Control" tension (proving the hypothesis incorrect). Also, resonance was observed in all tension scenarios except for the infinite tension case.</p>	
<b>Summary Statement</b> This project examined the properties of resonance and the effects of varying tension on a system containing multiple pendulums by measuring the displacements of the released and non-released pendulums.	
<b>Help Received</b> Mother helped with board and obtaining materials; brothers helped with conducting experiments and understanding basic laws of physics	