



California Science Center
CALIFORNIA STATE SCIENCE FAIR
 2001 PROJECT SUMMARY

Your Name (List all student names if multiple authors.) Elisha K. Hoffman	Science Fair Use Only
Project Title (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9) The Effects of Voltage and Number of Coils on the Lifting Strength of Various Electromagnets	J0613
Preferred Category (See page 5 for descriptions.) 6 - Electricity & Electronics	Division J Junior (6-8) J Senior (9-12)
Abstract (Include Objective, Methods, Results, Conclusion. See samples on page 14.) Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.	
<p>OBJECTIVE: How does the number of coils and the amount of voltage change the lifting strength of an electromagnet? I hypothesized that lifting strength would increase with voltage and number of coils used.</p> <p>MATERIALS AND METHODS: I made electromagnets with different numbers of coils, gauge wire, and using various voltages to lift BBs, which were counted and weighed. I also tested a manufactured toroid electromagnet. Each experiment had 10 replications and all results were analyzed using ANOVA. I then used Polynomial Regression to show the actual relationship between voltage or coils and lifting strength.</p> <p>RESULTS: Lifting strengths increased with voltage and number of coils used. Lifting strengths increased at low voltages, did not increase as much at higher voltages, and always increased with the number of coils. The strongest magnet was made with thin-gauge wire and 2400 coils. Based on my results, I recommended up to 12 volts be used, or no more than 12-20 grams weight are to be lifted, if using the manufactured toroid magnet in the design of a toy crane.</p> <p>CONCLUSIONS: Electromagnets show greater lifting strengths when more voltage is used but most magnets saturate at higher voltages. Lifting strengths increase with the number of coils used, and despite the increase in resistance of very thin gauge wire, winding a core with a very large number of coils using very thin wire increases magnet strength a lot. Regression analysis is a powerful tool for empirically predicting how electromagnets can actually be used for designing products like toys.</p>	
Summary Statement (In one sentence, state what your project is about.) I tested different voltages and number of coils to determine the lifting strength of various electromagnets.	
Help Received in Doing Project (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4. San Mateo Electronics checked my wiring diagram and helped me pick out the correct potentiometer. I had my dad use his Skill saw to cut the wood I used to build my demonstration.	