



**CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY**

Name(s) David K. Crowther	Project Number J0708
Project Title What's the Big Attraction? How to Make an Electromagnet More Powerful	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Determine the characteristics of an electromagnet that produce maximum holding force. I varied core length, core diameter, wire size, number of turns and power applied.</p> <p>Methods/Materials Materials: Threaded rods, steel washers and nuts, angle iron, magnet wire, hack saw, grinder, screws, wood, (2 x 4 and 2 x 6), drill, miter saw, epoxy, 2-DC power supplies, Volt/Ohm/Ammeter, bathroom and food scales, and steel tools. I made magnets with a variety of configurations and tested them using multiple power settings.</p> <p>Results My measurements for the performance of the six magnets, using seven power settings from two power supplies, gave a range of holding forces for each magnet. Magnet #1 held 0.454 kg-1.36 kg. Magnet #2 held 0.227 kg-0.454 kg. Magnet #3 held 1.81 kg-3.18 kg. Magnet #4 held 3.63 kg-13.6 kg. Magnet #5 held 0.085 kg-2.27 kg. Magnet #6 held 0.454 kg-5.44 kg. Measurements of voltage and amperage across the magnets again provided a range of values across all power settings. Using these values to calculate the power applied to all six magnets showed that there was a broad range for power (Watts) applied to the magnets (0.16 Watts to 41.0 Watts). Efficiency of the magnets (kg holding force per Watt) showed magnet #4 had very high efficiency at lower power settings and magnet #2 had very low efficiency at all power settings.</p> <p>Conclusions/Discussion After building and testing six electromagnets, magnet #4 proved to be the strongest electromagnet at all power levels. This electromagnet has the largest (2.54 cm) core diameter, larger wire gauge (22 AWG), a short coil length (2.54 cm), and moderate wire length (75.6 m). Magnet #2 was the weakest. Performance of magnet #6 proved that a major limitation to holding force in electromagnets is the resistance of the wire in the coil. Higher resistance reduces the amount of power that can move through the coil to produce a magnetic field.</p>	
Summary Statement I designed and tested electromagnets to determine the characteristics that produce the most holding force.	
Help Received My Dad assisted me with buying materials and designing magnets. He also provided extra hands, training, and safety tips for the tools I used.	