



**CALIFORNIA STATE SCIENCE FAIR  
2011 PROJECT SUMMARY**

<b>Name(s)</b> Ryan D. Kmet	<b>Project Number</b>  31307
<b>Project Title</b> Vortex Power	
<b>Objectives/Goals</b> The United States military and various law enforcement agencies are studying the use of non-lethal weapons to reduce the potential for casualties, reduce the risk of alienating people from humanitarian efforts, and prevent escalation to lethal force. Such a weapon, a vortex cannon, could be created based on Bernoulli's principle. The increased speed of a core of air fired from a vortex cannon would create increased pressure around the core, while there would be decreased pressure within the core. This principle would allow this toroid of air to remain focused and sustained instead of immediately dissipating, making an ideal non-lethal weapon. <b>Abstract</b> The United States military and various law enforcement agencies are studying the use of non-lethal weapons to reduce the potential for casualties, reduce the risk of alienating people from humanitarian efforts, and prevent escalation to lethal force. Such a weapon, a vortex cannon, could be created based on Bernoulli's principle. The increased speed of a core of air fired from a vortex cannon would create increased pressure around the core, while there would be decreased pressure within the core. This principle would allow this toroid of air to remain focused and sustained instead of immediately dissipating, making an ideal non-lethal weapon. <b>Methods/Materials</b> I constructed a vortex cannon using a plastic trashcan, plastic trash bags, a bungee cord, duct tape, and a tennis ball. By placing the open end of the cannon over a charcoal snoker before each set of firings, I was able to make each toroid fired visible. I carefully measured from a determined mark on the cannon table to a determined mark on the target table at distances of 6, 8, 12, 13, and 14 feet. I then set the cannon and the targets. I repeatedly fired the cannon from increasing distances until it became ineffective, recording the time from release of the cannon to contact with the target in order to estimate feet per second the release of air traveled. <b>Results</b> Though very effective and with spectacular results at the short distances of 6 and 8 feet, the cannon was less effective at 12 feet, even less effective at 13 feet, and completely ineffective at 14 feet. This does not mean a similar vortex cannon could not be effective at a distance of 15 feet or even greater. Adjustments could be made to the cannon to increase its potential, including the construction of a sturdier cannon and the addition of a fuel source to create a more powerful expulsion of air with more significant results. <b>Conclusions/Discussion</b> Results showed positive effectiveness of a vortex cannon at short distances with the application of minimal force. In real-world situations, a properly constructed vortex cannon has the potential to allow the person or authority employing its use to temporarily stun and subdue a subject without having to employ potentially dangerous chemicals, electrodes, or force that is more lethal.	
<b>Summary Statement</b> An effective non-lethal weapon, a vortex cannon, can be created on Bernoulli's principle.	
<b>Help Received</b> Mother helped purchase materials and took pictures; stepfather operated charcoal starter and stopwatch	