



**CALIFORNIA STATE SCIENCE FAIR  
2009 PROJECT SUMMARY**

<b>Name(s)</b> <b>Matthew G. Smith</b>	<b>Project Number</b> <b>J0222</b>
<b>Project Title</b> <b>The Perfect Trebuchet: Effects of Arm Length and Counterweight on the Projectile Distance</b>	
<b>Abstract</b> <b>Objectives/Goals</b> The objective is to determine how changing the arm length or counterweight mass affects a trebuchet's projectile distance? I think that the combination of a longer arm length and a heavier counterweight will make the projectile go farther. <b>Methods/Materials</b> Change the arm length and/or counterweight to see its affect on the projectile distance. First thing is to obtain the materials to build a trebuchet. Then make the trebuchet. Next is to choose different combinations of arm lengths and counterweight masses. Then choose a projectile to launch. Next, launch and observe their results. Continue to test different combinations until all of the combinations have been tested. Lastly, record their results and answer the problem. Materials used: 14 Screws (6.35 cm) 4 Carriage Bolts (8.89 cm) 6 Washers 6 Lockwashers 6 Nuts 28 Screws (3.175 cm) 1 Bushing (1.27 cm 10.16 cm thick) 2 Carriage Bolts (6.35 cm .9525 cm thick) 2 Copper Pipe (1.27 cm x 10.16 cm long) 4 Wing Bolts (.635 cm x 5.715 cm) 20 Captive Nuts (.635 cm) 1 T Splice 2 3 7/10 x 3 7/10 x 78 7/10 cm boards 4 3 7/10 x 3 7/10 x 74 7/10 cm boards 3 3 7/10 x 3 7/10 x 12 7/10 cm boards 2 3 7/10 x 3 7/10 x 64 7/10 cm boards 2 3 7/10 x 3 7/10 x 44 9/10 cm boards 1 3 7/10 x 3 7/10 x 90 1/2 cm board 1 2 x 6 4/10 x 83 2/10 cm board 2 2 x 6 4/10 x 38 1/10 cm boards 1 Racketball <b>Results</b> It looks as though the longest arm never had a chance to reach its farthest distance; even at the max weight of 22.68Kg. The shortest arm length achieved its peak distance at approximately 14kg and had the farthest distance out of all at 13.61kg, but it did not improve at any higher weight. The longest arm length never achieved its peak distance and had the best distance out of all the arms. I used a racquetball for a projectile in all of the tests. <b>Conclusions/Discussion</b> My hypothesis, that the combination of a longer arm length and a heavier counterweight will make the projectile go further, was approved based on my results. I learned that at some point adding more weight will not help make the projectile go any further. This was a fun experiment and I liked learning how to use all of the power tools necessary to build the trebuchet.	
<b>Summary Statement</b> This project measures the affects of the arm length and counterweight of a trebuchet's projectile distance.	
<b>Help Received</b> Dad helped supervisor the use of power tools and making the video. My whole family helped to measure the distances.	