



**CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY**

Name(s) Evan H. Wank	Project Number J0229
Project Title Does the Length of the Arm of a Catapult Affect the Distance of an Object Thrown?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The goal of this project is to determine if the length of the arm of a catapult affects the distance of an object thrown.</p> <p>Methods/Materials I researched catapults to determine the best type to use to test varying arm lengths. Instead of using a lever-style catapult such as a trebuchet, I decided to use a torque-style catapult where the moment arm rotates around a pivot point. Using PVC pipe, a wooden dowel, a threaded rod, and large rubber bands, as well as other parts, I designed and built a catapult with an adjustable arm. The rubber bands are used to provide the energy to fire a small wooden ball. I set the catapult up next to a large area of sand and adjusted the catapult arm from 60 cm. to 100 cm. in 10 cm. increments. Every length was tested five times to determine an average throw at each arm length. Sand was used because the ball would leave a divot which made it easier to measure.</p> <p>Results Overall, as the arm length of the catapult increased, the ball was thrown farther.</p> <p>Conclusions/Discussion My hypothesis was that a ball being thrown from a catapult, will travel a farther distance if it is thrown using a longer arm. This hypothesis was correct. Using a catapult, I extended the arm to different lengths to see how far a wooden ball would be thrown. The average distance thrown from arm length 1 (60 cm.) was 339.85 cm., while the average distance thrown from arm length 3 (80 cm.) was 352.04 cm., and the average distance thrown from arm length 5 (100 cm.) was 386.84 cm. This shows that extending the arm length does increase the distance thrown.</p> <p>The results supported my hypothesis. My research showed why I got these results. According to the formula for a moment arm, which is $\text{torque} = \text{force} \times \text{moment arm}$, the more torque, the farther the ball would be thrown. Therefore, if you increase the moment arm, this will increase the torque. This is why the ball was thrown as far as it was.</p> <p>This experiment provides useful results. The moment arm of the catapult acts like a person throwing a baseball or a football. A person with a longer arm should be able to throw a ball farther.</p>	
Summary Statement My project was to determine whether the length of the arm of a catapult affects the distance of an object thrown, based on the formula for a moment arm.	
Help Received My father helped me design and build the catapult as well as assisted me in performing the experiment.	