



**CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY**

Name(s) Timothy Lui	Project Number S0217
Project Title The King of Fling: An Analysis of Counterweight to Projectile Energy Transfer in a Trebuchet	
Abstract Objectives/Goals Every year, the MESA program hosts a national engineering design competition and this year's competition is the trebuchet. The object of this project is to gain a better understanding on the behavior and mechanics of energy transfer in trebuchets by analyzing the relation between projectile mass and the ratio of projectile kinetic energy to counterweight potential energy. Methods/Materials A special type of trebuchet (floating arm trebuchet) was constructed that allowed for a vertical counterweight drop as well as seven copper projectile masses measuring 12.5g, 25g, 50g, 75g, 100g, and 150g. A 50m tape measure was required to measure distance and a stop watch was required to measure time of flight. Each projectile was launched and the time and distance of each flight was recorded. From the given flight distance and time, the original launch vector can be calculated and kinetic energy of the projectile could be measured. Results The relation is closely related to a sigmoid curve, with the less massive projectiles having a lower KE/PE ratio and more massive projectiles having a higher KE/PE ratio. In essence, the greater the projectile mass, the greater the energy efficiency (defined as $KE(\text{projectile})/PE(\text{counterweight})$). Conclusions/Discussion The hypothesis that the mass of the projectile affected the energy transfer ratio was supported by the experiments. The less massive the projectile, the less of the counterweight's potential energy was transferred to it and vice versa. The results help trebuchet designers and hobbyists understand the relation between the projectile's mass and the energy efficiency of a trebuchet allowing them to better specialize their designs for specific purposes.	
Summary Statement My project is an analysis of energy transfer from the counterweight of a trebuchet to the projectile.	
Help Received I utilized the school's woodshop and machinshop tools under the supervision of Mrs. Miller. The mathematics involved in calculating the vectors was taught to me by my physics teacher Mr. Schurr - also from whom I borrowed the measuring tape. I also borrowed a miter saw from Mr. Fairbrother	