



**CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY**

Name(s) Henry A. Mason	Project Number J1812
Project Title Who Packs the Most Punch, Superman or Flash? A Study of the Relationship between Mass, Velocity, and Force	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals With Superman and Flash as metaphors for "big and strong" versus "small and fast," this projects investigates the relationship between mass, velocity, and force, illustrating how mass and acceleration affect the displacement of an object at rest.</p> <p>Methods/Materials Using a pendulum (because it is easy to predict its speed), two different lead weights (enameled for safety) will be used with the larger, blue weight representing Superman's larger mass and the smaller, red weight representing Flash's smaller mass. Each lead ball will be raised on the pendulum at different angles and let go, allowing it to strike an object at rest, representing a "bad guy," knocking it over. Afterward, I will measure how far it was displaced in each test.</p> <p>Results The maximum average throw-back using the smaller, red ball, when swung from 90 degrees, was 77cm, with the ball having reached 300cm/sec. Almost the same throwback distance for the blue ball happened with the pendulum having been swung from 70 degrees, with that ball having reached 246cm/sec. The red ball's kinetic energy at that speed should have been 1.17J. The same kinetic energy should happen for the blue ball between 70 and 80 degrees. The kinetic energy of the blue ball at 70 degrees should have been 1.03J. I expected the throwback to be more, which I do find in the blue ball's median throwback for 70 degrees.</p> <p>Conclusions/Discussion The experiment does prove my hypothesis that a small mass can exert more force when traveling at a high velocity than a larger mass traveling at a lower velocity, but not as much as I had expected. In one calculation at the end of my trials, I figured out that the red ball swinging from 90 degrees would exert the same force as the blue ball swinging from around 0.02 degrees, which works out to the same proportion as the example in the video of Flash traveling at 36,787,559,000 m/s and Superman moving at 600 m/s when facing off against their "bad guys."</p>	
Summary Statement This project gauges the impact of two objects of different mass on the same stationary object.	
Help Received David Mason helped assemble final pendulum; Valeria Mason contacted DC Comics for permission to use images; Dr. Charles Prince recommended physics textbooks; Dr. Graeme Mason coached for presentation; Mr. Ryan Flagg helped appreciate Newton's laws and math	