Greater San Diego Science and Engineering Fair
2015 PROJECT SUMMARY

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Project Title:

The Relationship Between a Crater's Diameter and the Projectile's Energy

Abstract

Objectives/Goals
The objective of this project is to use household materials to calculate a relationship between any crater and its projectile energy. It can be applied to save human lives.

Hypothesis
It was predicted that the diameter of the crater would be equal to the energy of projectile to the power of 0.2, the equation being $D = E^{0.2}$.

Methods/Materials
The materials used in this project were tennis balls, a sand basin, measuring tools, a pegboard-prong contraption, and a balance. The pegboard-prong contraption was formed from a 5 foot pegboard attached with screws to a wall. Double hook prongs were attached to it and a PVC pipe was wedged in between. A ball was dropped from either different heights or different masses and the diameter was recorded.

Results
Overall, when all the points were plotted from the tests, all of the constants were found. The height testing proved to have much more accurate results than the mass testing. Since the margins for the mass testing were very low, the differences were also low and hard to measure. But using the data the equation of $D = 0.0325 + 0.0489E^{0.2589}$ was formed.

Conclusions/Discussion
The equation relating crater diameter to projectile energy is $D = 0.0325 + 0.0489E^{0.2589}$. The results of the validation to the Meteor Crater in Arizona came out a little bit less than expected, possibly because of the underestimation of the effect of mass. This information can also be applied to real-life issues. In 2013, the Chelyabinsk Meteor was a fraction of a degree from hitting Earth, and if it did, it would have destroyed an area equivalent to the size of Manhattan in New York. It can also be used to derive what caused different craters on the moon, and it shows that the Alphonsus Crater had to be caused by a projectile traveling at 20 meters per second with a mass of 600 billion kilograms. This information can be used to evacuate people until technology to stop asteroids is produced, expanding upon the knowledge about asteroids.

Summary Statement

This project derived the relationship between the diameter of a crater and the kinetic energy of a projectile at impact.

Help Received

I received assistance in this project from my father, my mother, my two mentors, Mr. Pakus and Dr. Blanco, and my science teacher, Mrs. Gillum.