CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
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Project Number
J0208

Project Title
The Longer the Arm, the Farther the Throw?

Abstract

Objectives/Goals
I like playing golf and often wondered why the length of a club affects the distance the ball travels. It feels like the longer clubs just have more power when I swing them! I wanted to find out what it is that makes a longer club hit the ball farther.

Methods/Materials
My first thought was to use different length golf clubs to test their effect on a balls travel, but I realized it would be difficult to regulate the swing. Then I remembered a PBS special on the Trebuchet. A Trebuchet is a gravity powered Medieval battle weapon. It was the successor to the Catapult because of its superior range and accuracy. A heavy weight is attached to one side of a throwing arm, while a rope and sling are attached to the other. The sling cradles the projectile. When the weight is released, it swings downward, and raises the other side of the arm. The length of the rope extends beyond the arm and the sling releases the projectile at great velocity. Since building a full scale Trebuchet was out of the question, I decided to make a miniature one of my own design. I based it off several pictures on the internet. I kept it down to a foot high to limit the projectile's distance.
My plan was to use different pivot points in the throwing arm to test the different lengths. When I tried this, I realized that it also changed the relation of the weight to the axle. This changed the force that was applied to the throwing arm. In order to eliminate this, I had to make different arms for each length. I performed tests with a ten-pound weight initially, but settled on seven-pounds to better control the distance traveled.
I tested throwing arm lengths at 4, 6, 8, 10, 12, 14, 16, and 18 inches. I performed five throws for each arm, recorded the tests, and averaged them out.

Conclusions/Discussion
My tests proved my hypothesis correct! The longer the throwing arm, the farther the throw! Each time I increased the length of the arm, the distance the projectile traveled increased. I started with a four-inch arm, roughly the same distance as that between the weight and axle, and the projectile consistently went straight up in the air or backwards. Once I moved to a six-inch arm, the projectile went in a forward motion, but not very far.
What I realized was that as the arm grew in length, the force at the end of the arm also grew. This force is referred to as centrifugal force, and it increases as the length of the arm increases.

Summary Statement
I believe that the longer the striking arm (club) or throwing arm, the farther the object being struck or thrown will travel.

Help Received
Father helped construct trebuchet.