CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
David A. Zarrin

Project Number
J0240

Project Title
The Effect of Wheels on Catapult Efficiency

Abstract

Objectives/Goals
The Greek inventor of the catapult, Archimedes, found that wheels increase launch distance of projectiles. He might not have known the physics behind his experiments. I wanted to understand and prove the physics of why adding wheels to a catapult increases launch distance of a projectile.

Methods/Materials
I found a catapult simulator on the Internet. After 40 simulated trials, I found the best arm ratio dimension. I built a catapult with removable wheels using the simulated dimensions. To clearly see the launch motion, I used a video camera to tape each launch with and without wheels. I loaded the video into a computer and analyzed the motion frame-by-frame until I understood the effect of wheels on catapults.

Results
I found that wheels help transfer more of the weight#s potential energy to the projectile. Wheels allow the weight to drop faster in a straight line thus transferring more energy in a shorter amount of time to the projectile. Also, the projectile is launched while the catapult has a forward motion adding to the speed and launch distance of the projectile. In my experiment, the weight dropped in 0.33 sec. with wheels and 0.37 sec. without wheels. Wheels increase the launch distance by 21.5%

Conclusions/Discussion
Catapults with wheels launch projectiles farther than catapults without wheels because:
1. Weight on the catapult wants to go straight down (gravitational force).
2. For the weight to drop straight down, the catapult must move backward and then forward.
3. Forward motion of the catapult happens as the projectile is launched, giving the projectile a boost.
4. The catapult with wheels launch time was 0.33 sec. According to the video frames, removing wheels slowed the launch time down to 0.37 sec, transferring less energy to the projectile.
5. In catapults without wheels the weight is forced to travel down in an arc.
6. When this happens the arm slows down, decreasing the amount of energy transferred to the projectile.
7. There is no boost from the forward motion because without wheels, the catapult cannot move.

I learned: 1. Physics and affect of catapult wheels on launch distance.
2. Newtons Laws, potential and kinetic energy concepts.
3. Computer simulators to find ideas without building real models.
4. Measurement techniques using video cameras.
5. Calculating object speeds using distance and time.
6. Using computer programs: Photoshop, Premiere Pro, and Excel.

Summary Statement
I wanted to understand and prove the physics of why adding wheels to a catapult increases the launch distance of a projectile.

Help Received
Mr. Simon Zarrin (father) helped with dangerous aspects of the project (power tools, catapult safety)