CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
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Project Number
S0215

Project Title
Swing This Way!

Abstract

Objectives/Goals
Is the #harmonic# motion of a pendulum affected by friction? If so, does weight help resist the friction? Can a mathematical formula be developed to determine the damping factor?

Methods/Materials
To construct the pendulum frame:
Wood; Tools to build the pendulum; Saw blade, nail gun wood glue hammer
To construct the pendulum:
Screw hook; Protractor; Small weights; Fishing line; Straws; Tape; Ruler
Computer with TI- Connect Software with CBL/CBR software; Calculator Base Ranger; USB link cable

Procedures:
Assemble pendulum frame; Collect data with motion detectors; Edit data tables; Use exploratory data analysis to analyze the damping factor; Use statistical inference to determine the effects of mass

Results
My findings resulted in me proving the standard textbooks wrong. The period of motion of the pendulum indeed has a damping factor that can be mathematically evaluated with the damp motion theory. My data also resulted in showing that heavier masses resist friction more efficiently.

Conclusions/Discussion
My first hypothesis was that the motion of the pendulum would be affected by friction through time. Data collected in the second part of the experiment demonstrates this hypothesis to be correct. In every case, the amplitude and displacement of the pendulum bob from its equilibrium decreased in gradual amounts. Data collected with the motion detector shows the displacement of the pendulum through time as well. The data also proves the hypothesis to be correct. My second hypothesis was that the weight of the pendulum would affect the resistance of friction. Through exploratory data analysis and the relation of mass to weight, I was able to conclude that the weight does indeed affect the resistance of friction. The average difference in amplitude between each half swing for a mass of 20g was 1.2583° and a standard deviation of 1.1365° and for a mass of 100g the mean was 1.1° with a standard deviation of 0.8699°. Therefore, the weight as it is related to mass by the equation W=mg (Weight= (mass)(acceleration due to gravity)), does affect the resistance. Heavier objects resist friction more easily.

Summary Statement
Mathematically proving that the assumed harmonic motion of the pendulum consists of a damping factor.

Help Received
Mr. Kyle Atkin helped with motion detectors and statistical inference; Dr. Scott provided the complex pendulum