CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S1419

Project Title
The Die is Cast: The Height at Which the Drop of a Die Switches from Deterministic to Random Results

Abstract

Objectives/Goals
The purpose of this experiment was to see at what height a die that was dropped on a firm textbook became random.

Methods/Materials
A Mindstorms robotic Lego machine was constructed to drop a casino-quality die at heights of one-centimeter intervals starting at zero. At each centimeter, the robot dropped the die a hundred times in an even manner.

Results
At heights from zero to six centimeters above the ground, the number of times the number one face landed upright was more than any of the other number faces. The sides of the die, faces two through five, became more frequent at heights of six to eight centimeters. By eight centimeters, the bottom of the die (face six) had increased to the frequency of the other faces. Using the chi-square statistical analysis test, the die drop results were found to be random when the die was dropped from at least twelve centimeters above the ground, showing the hypothesis to be correct.

Conclusions/Discussion
The die became random at higher heights because the farther the die was from the ground, the more potential energy was being converted to kinetic energy when it contacted the ground. The die, therefore, then bounced more. This project used a uniform surface, a textbook, throughout the entire experiment. Future experiments could be performed to see if dropping the die on different surfaces can affect the height at which the die becomes random. The die could be dropped on plastic, wood, metal, carpet, foam, and stone, from the height of twelve centimeters.

Summary Statement
This experiment will investigate the relationship between how high a die will have to be dropped on a textbook until the die produces random results.

Help Received
Step-brother helped build the robot