



**CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY**

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Project Title <p align="center">Flip of a Coin, Roll of a Die, Turn of a Door: Is It Fair? A Study on Probabilities</p>
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<p align="center">Abstract</p> <p>Objectives/Goals Coin- Mathematician Persi Diaconis used a machine to flip coins and he discovered that if a coin is flipped with heads starting out facing up it will land facing up. The objective of this experiment is to see if this is true if a human flips the coins, and does it apply on different surfaces. Dice- the objective of this experiment is to determine if the shape of a die effects the fairness of the roll. Door- the objective of this project is to determine if the probability of picking the right object is better by switching your initial choice with a variant of the shell game, where one choice that is for sure wrong is removed by the person in charge and shown to you after you make your first guess. Is it better to stay or switch?</p> <p>Methods/Materials Coin- I will flip a quarter starting heads up over the first surface and record the ending position. I will do this 200 times. I'll repeat this experiment again, except the quarter will start out with tails up. I will repeat this experiment using 5 different surfaces with various density and textures. Dice- I will roll each polyhedral die 25 times per side (tetrahedron, cube, octahedron, decahedron, dodecahedron, icosahedron). I'll make a non-isohedral pentahedral out of cardboard. I'll roll the non-isohedral die 25 times per side. Door- I conducted 100 trial with a computer simulation of the three door variant.</p> <p>Results Coin- When a human flips a coin starting heads up it has a 50% chance of landing heads up, landing surface does not make a difference. Dice- For all the die, except the non-isohedral pentahedral, the die landed within 10% of the expected value for each face. The expected value was the total number of rolls divided by the number of faces. Door- Computer simulation showed that switching got the right door 65% of the time, while staying got it right 35% of the time.</p> <p>Conclusions/Discussion Coin- Diaconis found that when a machine tosses a coin it more likely to land the way it started, when a human tosses a coin it does not. Dice- The tetrahedron, cube, octahedron, decahedron, do decahedron and the icosahedron are fair dice. The experiment and the research showed this to be true based on Eulers Equation. Non-isohedral pentahedron isn't a fair die because the faces are not identical. Door- Experiment showed that when there are three doors and one of the doors is eliminated that there is a</p>
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Summary Statement <p>This project investigates if different games of chance are fair.</p>

Help Received
