Galton Board: A Practical Demonstration of Probability

Most people have some awareness of chance and probability. The probability of an event occurring can be assigned a number between 0 and 1; if the probability of occurrence is 1, then the event is certain to happen. If it is zero, it will never occur. Naturally, most events will have a probability somewhere in between. Since a die has six faces, if it is fair, the probability of throwing any particular number is 1/6. If you toss a coin, the probability of a head is ½. What happens if you toss a coin ten times? Will you get five heads and five tails? Suppose you get ten heads; what is the probability of getting a head on the next throw?

Mathematics can be used in an amazingly wide range of ways to predict the probability of an events occurring but, if the actual event is random, like a coin toss, it cannot predict the outcome of the next throw. However, if enough trials are made, the mathematics can be used to give a good estimate of the number of events which occur. So you might not be surprised if you threw four heads out of a total of 10, but you would be very concerned about the quality of your penny if you scored 4,000 heads out of 10,000 throws, even though the proportions are the same! Estimating probability by performing a large number of trials is experimental probability and the Galton Board is an example of this.

The board consists of a triangular arrangement of pins and a mechanism for introducing balls at the top. When a ball hits a pin, it can continue either to the left or right. It then drops down to the next row where it is faced with the same possible outcomes. At each row, left or right both have a probability of 0.5, just like tossing a coin. Eventually, when it has bounced its way down all the rows of pins, it drops into a channel where it is collected. The questions students are faced with, before the experiment is run, is how many balls are likely to drop into each channel and what will the shape of the filled channels be? Students will begin to realise that the number of balls in each channel is a measure of the probability of a ball's taking that path. In fact, the probability of a ball's ending up at the end channel is exactly the same as throwing the same number of consecutive heads as the ball has undergone bounces!

Mathematically, the shape approximates the Binomial Distribution which is approximated by the well known bell shape of the Normal Distribution if there are enough rows of pins.