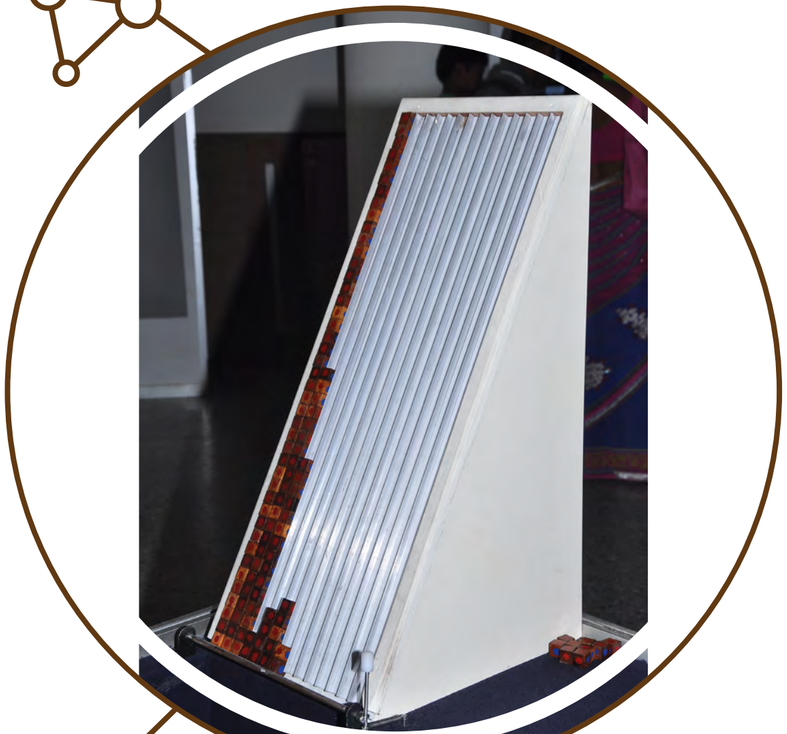
6.1

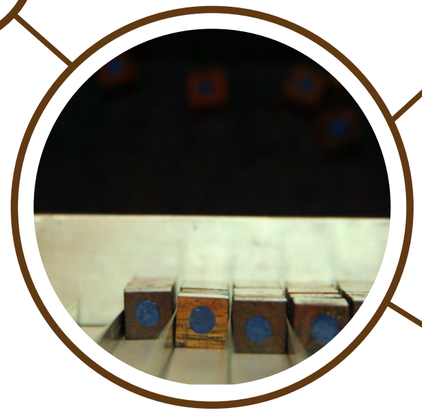
Dice

The dice used in this experiment are a bit special: some of their sides have a red dot while all others have a blue dot, for example, 2 sides with red dots and 4 sides with blue dots. The game goes as follows: A large number of dice are thrown, and ones showing the red color are collected, and stacked in a column. The remaining dice are thrown again, and the ones showing red are again collected, and stacked in a column next to the earlier column. This process is repeated until one exhausts all the dice. Watch how the height of the columns vary!

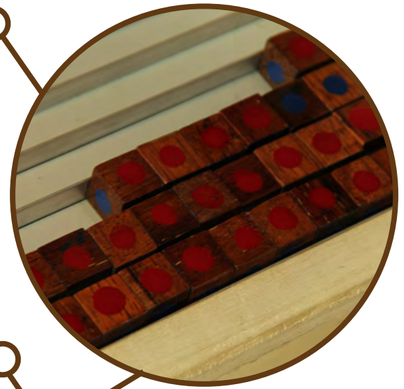
What is the math? This game highlights the definition of *probability of an event* and also illustrates what are called *laws of large numbers* in the probability theory. We all know that a fair die shows up the number 1 with probability 1/6. Does it mean that if we throw a die six times, we must observe the number 1 exactly once out of the six throws? No. What it really means is that if we throw a die a large number of times, then approximately one sixth of the times we shall observe 1, which is a consequence of what are known as *laws of large numbers*.



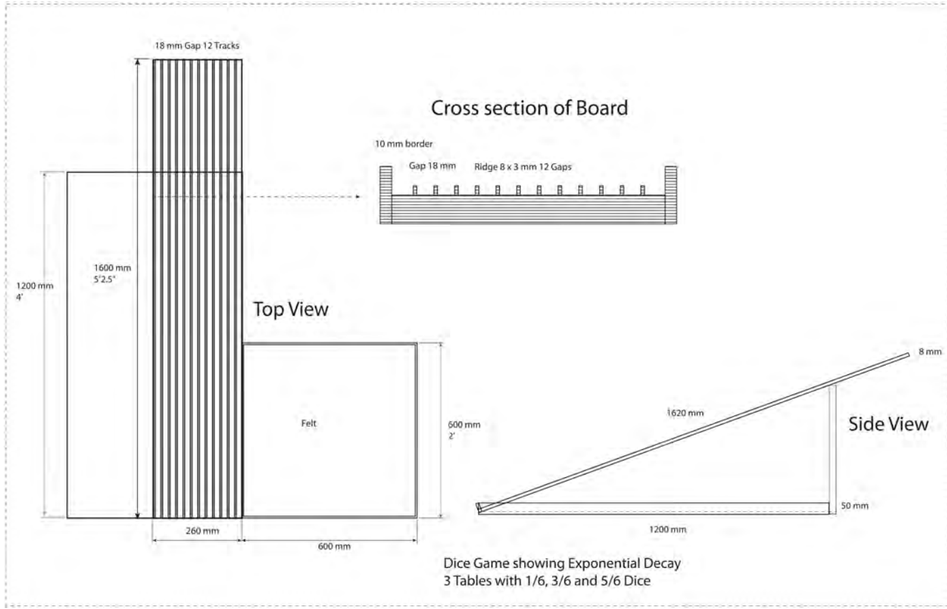
6.1



game naturally introduces the exponential function as well.



Thus, if the number of dice (N) is large, then approximately $N\frac{1}{6}$ of the dice are going to show up 1 in the first throw of dice. Then, at the second stage, of the remaining $N\frac{5}{6}$ dice, approximately $N\frac{1}{6}\cdot\frac{5}{6}$ are going to show 1 in the second throw of dice. Thus, at the k-th stage, approximately $N\frac{1}{6}\cdot\left(\frac{5}{6}\right)^{k-1}$, which represents an exponential function in the variable k. Thus this



Dice Game showing Exponential Decay
3 Tables with 1/6, 3/6 and 5/6 Dice