



# **Ozobot Bit Classroom Application: Randomness with 6-Sided Die Rolling**

## **Created by**

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## **Topics**

Math (statistics, random variables,  
long term expected value, runs in a sequence)

Data collection

## **Ages**

Grades 4-8

## **Duration**

Approx. 30-40 min

# Ozobot Bit Classroom Application: Randomness with 6-Sided Die Rolling

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## INTRODUCTION

Randomness is everywhere. It surrounds us. The individual heights of students in your classroom are random. The motion of molecules in a gas bumping each other and the sides of its container is random. The flip of a coin can determine which goal a football team will defend. Random draws from a well-shuffled deck of cards can affect who wins in a game of poker. Players wager on the outcome of random throws of a pair of dice in a craps game. This list could go on-and-on.

**Classroom Exercise #1:** Ask students to think of events that involve randomness.

In this classroom application your students will be investigating randomness involved in rolling an ordinary six-sided die that is simulated by Ozobot Bit. Each run of the OzoBlockly program (*dieRollFinal.ozocode*) associated with this application consists of 30 rolls of a single die. Ozobot will allow the student to see the result of each successive roll, and then Ozobot will present a summary of the rolls in a "bar graph" format, showing the number of times out of 30 that 1, 2, 3, 4, 5, and 6 were rolled. The "maze" used by this program is shown on the next page and can be printed for students lab groups.

**Classroom Exercise #2:** Ask the students how many times, in the long run, each of the six-faces of the die would be expected to appear in 30 rolls of the die?

Referring to the "maze" on the next page, here is how Ozobot interacts with the maze. You will note that there are two sections in the maze. The smaller top section is red—this is where Ozobot will simulate rolling the die 30 times, displaying the result as he randomly picks one of the six red paths. The larger bottom section is blue—this is where Ozobot will summarize the results of the 30 rolls in a "bar graph" format.

Ozobot Bit is initially placed at the location labeled "Start" facing the direction shown by the arrow, and his leading edge should not extend beyond the curved gray line. Upon pressing the "Start" button twice, Ozobot will show a RED LED and begin simulating the 30 tosses of the die. After completing the thirty tosses, Ozobot will change to a BLUE LED and follow the black line down to the blue section of the maze. He will travel up each successive column and stop at the total number of rolls for each of the six possible die rolls. When he stops, his LED will stay WHITE for 4-seconds, allowing the student to jot down the number of times tossed. If he stops at the number eight, but displays a RED LED for four seconds, the red is telling the student the number of rolls actually exceeded 8. If the number of tosses was equal to eight, the LED would stay WHITE for four seconds, which is the normal color. In effect, Ozobot Bit has constructed a dynamic "bar graph" summarizing the thirty rolls of the die. After displaying the total numbers of rolls for a die roll of 6, he will go to the bottom right corner of the maze, stop, and turn off.

Students should calibrate Ozobot Bit on paper before running the program on the maze. The teacher can print copies of the maze on the next page for each lab group in the class. The teacher can load the program *dieRollFinal.ozocode* using the "Load Ozobot" feature on the OzoBlockly.com Web site.



**Classroom Exercise #3:** With two students per lab group (ideally), ask the group to run the program once. Have one student keep a tally on a piece of paper showing the number of times that Ozobot simulates the roll each time he traverses the RED section of the maze. Here is an example of how the tally might look:

1	
2	
3	
4	
5	
6	

Have the other student keep an actual detailed description of the thirty results as Ozobot traverses the RED section of the maze. Here is how this could look, and it corresponds to the tally above.

1	1	2	1	1	3	2	6	1	4	5	2	1	2	3	2	4	5	5	3	5	1	6	1	2	6	6	5	1	5
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1. Ask the students to recall their answer to *Classroom Exercise #2*—the expected number of rolls for each of the six possible results when rolling a die 30 times.
2. The tallies are clearly not the same for each of the six possible die tolls. Ask the students to suggest why this is the case.
3. In the above tally example, where 1 occurred 9 times, Ozobot would show the result in the blue section of the maze by stopping on 8 and then show a RED LED for four seconds, indicating a tally of more than 8. If you had not kept a tally on paper, and all you saw was Ozobot’s “bar graph” tallies, how could you determine the actual number of times that 1 was rolled? Would you be able to do this if Ozobot had rolled *more than 8* for two or more of the six possible rolls of the die?

**Classroom Exercise #4:** Have the students investigate the concept of a run. A run is an unbroken sequence of like numbers, even if the sequence has only one number. (In the sequence shown in Classroom Exercise #3, there are 22 runs of length 1, and 4 runs of length 2 (11, 11, 55, and 66).

Ask the lab groups to identify, from their sequence of 30 tosses of the die:

1. The number of runs obtained of length 1.
2. The number of runs obtained of length 2.
3. etc., to the longest run.

What seems to be the relationship between length of a run and frequency of the length of a run? (Answer: *The longer the run, the less frequent it occurs.*)

**Classroom Exercise #5:** In order to get a better idea of the concept of “in the long run”, have the lab groups combine their tallies into a single tally. So, if you had, say, eight lab groups, the combined tallies would represent  $30 \times 8 = 240$  rolls of the die.

1. Do the results shown in the combined tally appear to be more “evenly” distributed?
2. What is the expected tally for each of the six die rolls, in the long run, when combining the lab group tallies? (Answer: *1/6 of the total number of rolls of the dice for the combined lab groups.*)