

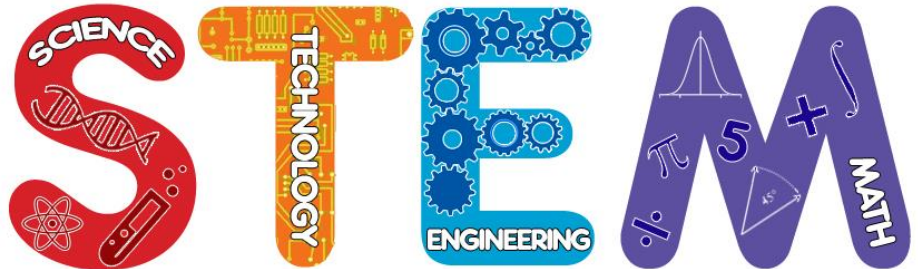
## The Beadery<sup>®</sup> Bead Color Frequency Table

### Materials Needed:

- 2 Colors of Beads
- Bag/Box to hold beads

### Skills Learned:

- Counting/Tallying
- Introductory Statistics



### Background:

Using frequency tables lets students learn about collecting data from a simple experiment and representing it in a way that allows easier understanding of data trends and patterns.

### Instructions:

1. Label the frequency table with a title so you know what data you are collecting.
2. Label the color column with the color that you are going to be counting.
3. Place two different colors of the same shape bead into a bag or box. The beads need to be the same size and shape so that the color is the only variable in the selection. Search for “beads for learning” on [www.thebeadery.com](http://www.thebeadery.com) to see a selection of two color pony bead packages.
4. Without looking, pick one of the beads from the bag/box and use tally marks to keep track of the data points. In this experiment, you are tallying the number of beads of the chosen color pulled from the bag/box. If you are keeping track of yellow beads and you pull a green bead, you would count that as 0 yellow beads. Pulling a yellow bead would count as 1 yellow bead.
5. When you have completed your data collection, count the tally marks for each row and record that number in the frequency column.

### *Example Frequency Table (picking 1 bead):*

Title:		
Color:	<b>Tally Marks</b>	<b>Frequency</b>
0		
1		

**Example:**

In this example, you have one green bead and one yellow bead in a bag and are blindly choosing one of the beads each time. If you repeated the bead pick ten times, you might pick the yellow bead six times and the green bead four times which would lead to a frequency table that looks like the following.

Title: <i>Picking One Bead from a Bag</i>		
Color: <i>Yellow</i>	Tally Marks	Frequency
0		4
1	<del>    </del>	6

Since both beads are the same size and shape, each color has the same probability of being picked. Therefore, the frequency of picking a yellow bead should be approximately the same as the frequency of not picking a yellow bead (picking green). Picking many more of one color than the other is still possible, but less likely than an equal distribution. If two yellow beads and eight green beads are picked, there is nothing wrong with the experiment or data, but it is less likely to happen.

**Things to ponder:**

- *What happens to the frequency if you take more samples?*

Try picking a bead 10 times, 20 times, 100 times to see if you still get yellow approximately half of the time. If you have a group of students each collecting data, combine all their data to see if the trend continues for the larger sample size.

- *What happens to the frequency if more than one of each color is in the bag, but you are still picking only one bead?*

Try 10, 20, or more of each color to see if the frequency changes. Since you are only picking one bead each time, does the larger set of beads to choose from effect the frequency?

- *What happens to the frequency if more than one bead is selected each time?*

Try picking four beads from the bag at a time. How does that effect the frequency?

**Instructions:**

1. Place at least as many beads as you plan to pick each time of two different colors into a bag/box. If you plan on picking four beads each time, you will need at least four yellow beads and four green beads.
2. Make a frequency table corresponding to the number of beads that you are picking each time. If you are picking four beads each time, you will need rows for 0-4.

Title: <i>Picking Four Bead from a Bag</i>		
Color: <i>Yellow</i>	<b>Tally Marks</b>	<b>Frequency</b>
0		
1		
2		
3		
4		

3. Without looking, pick four of the beads from the bag/box and use tally marks to keep track of the data points. If you are keeping track of yellow beads and you pull one green bead and three yellow beads, you would mark that as a 3.
4. Return the picked beads to the bag and repeat.
5. When you have completed your data collection, count the tally marks for each row and record that number in the frequency column.

**Example:**

In this example, you have ten green bead and ten yellow beads in a bag and are blindly choosing four of the beads each time. If you repeated the bead pick 50 times, you might get a frequency table that looks like the following.

Title: Picking Four Bead from a Bag		
Color: Yellow	Tally Marks	Frequency
0		6
1		14
2		18
3		9
4		3

Notice that the frequency is not equally distributed across all values. Since you are picking four beads each time that have two possible colors each, there are a total of 16 possible permutations ( $2 * 2 * 2 * 2 = 16$ ) of beads as listed in the table below.

Bead 1	Bead 2	Bead 3	Bead 4	Yellow Count	# Permutations
Green	Green	Green	Green	0	1
Green	Green	Green	Yellow	1	4
Green	Green	Yellow	Green		
Green	Yellow	Green	Green		
Yellow	Green	Green	Green		
Green	Green	Yellow	Yellow	2	6
Green	Yellow	Green	Yellow		
Green	Yellow	Yellow	Green		
Yellow	Green	Green	Yellow		
Yellow	Green	Yellow	Green		
Yellow	Yellow	Green	Green		
Green	Yellow	Yellow	Yellow	3	4
Yellow	Green	Yellow	Yellow		
Yellow	Yellow	Green	Yellow		
Yellow	Yellow	Yellow	Green		
Yellow	Yellow	Yellow	Yellow	4	1

From the above table of all permutations, you can see that only one of the 16 permutations (four greens) gives you a 0 and only one permutation (four yellows) gives a 4, while there are six possible permutations that will give a total of two yellow beads. These probabilities lead to the bell-shape of the normal distribution curve, represented by the black dotted line on the plot below. When the experimental frequency data is plotted on the graph, it can be seen to follow this bell-shaped trend.

