## Games with dice: what is your favorite number and sum?

Today we will play with dice. First with one 6 sided dice.
There are 6 sides on the dice. Six numbers. If we toss the dice, which number will be tossed? Do you like any of those 6 numbers more than the other 5?
Each student will toss dice many times and mark the number he/she is getting. We will repeat this until one of the numbers appears 10 times.
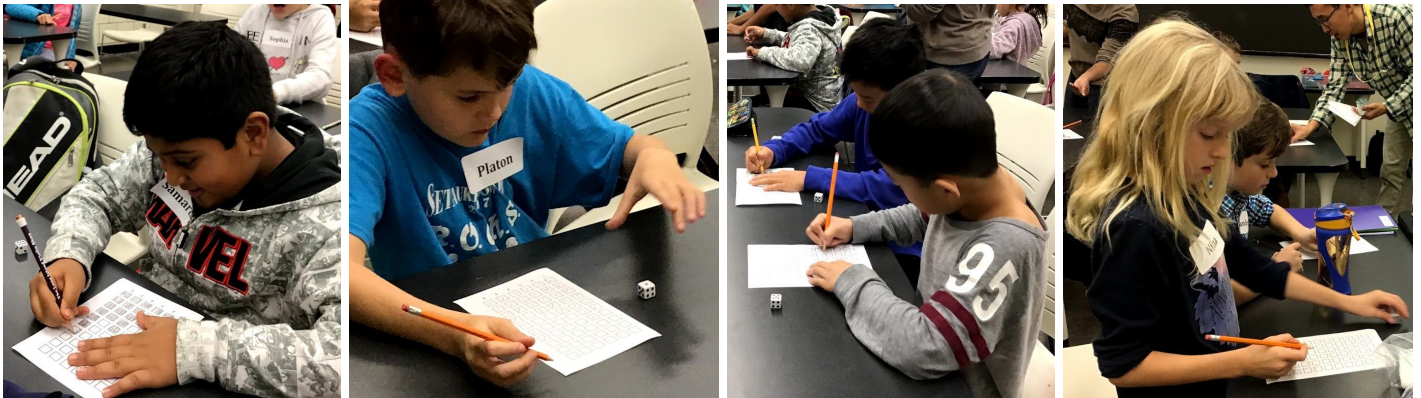

Then Lena will collect all the results in one chart on the board and we will discuss if there is such a thing as "better" number. Or maybe there isn't. And why? Is there any differences between dice sides? What will happened if we toss the dice many-many times?


Maybe there is no better number after all… all 6 numbers came out often, and no number is much more often than the other 5.

Let us now discuss what will change if we throw 2 dice at the same time?

If now we will throw two 6 sided dice simultaneously, what numbers we can get on each of the dice? What sum can we get? What is the smallest sum we can get? What is the largest sum we can get? Can we get sum of 1 or maybe 14? Even if we really try? We will fill the 6x6 table with all possible sums we can get from throwing two dice.
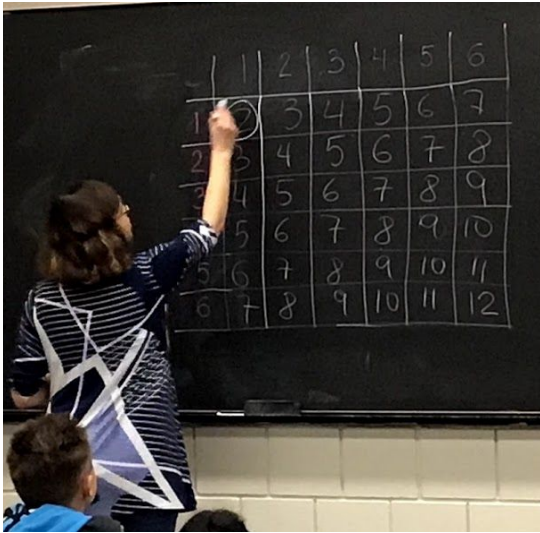
Are all the sums equally likely? Or do we have a "better" sum: the sum that we will get more often than others? To find this out, let us do an experiment: will throw two dice simultaneously, find the sum of the two numbers, record it by bubbling the right column of the grid given to you, repeat this until one of the numbers appears 10 times.
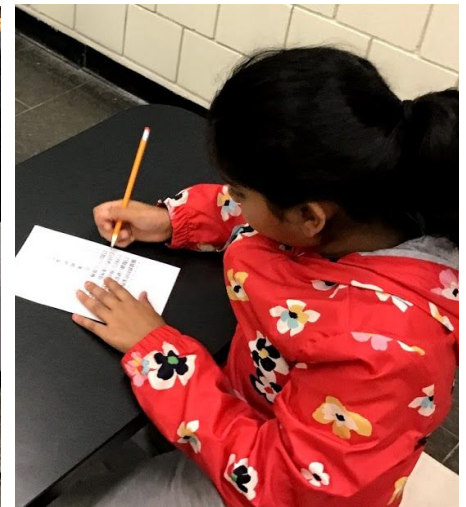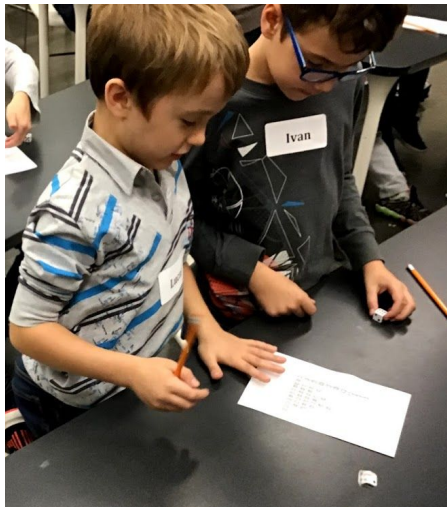
Now we will combine all our results in one graph and see the distribution. What number did you get more often?

It looks like number 7 is the sum we see most often. Is that correct? Let's try to understand it: is it something real, or just an accident? Let's count the number of different ways we can get each of the sums:
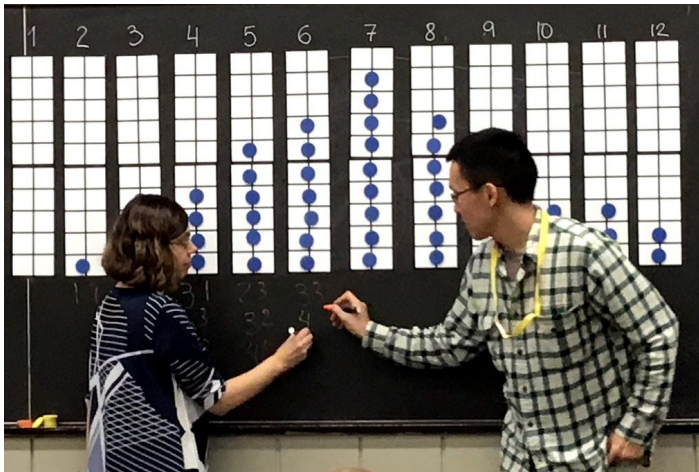
	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

- in how many ways can we get sum of 2? Just one way: 1+1.

- How about 3? 1+2 and 2+1 are possible options.

- What about 7? 1+6, 2+5, 3+4, 4+3, 5+2, and 6+1 for a total of 6 ways of getting sum of 7 when throwing 2 dice at the same time.

1	2	3	4	5	6	7	8	9	10	11	12
	1+1	1+2	2+2	2+3	3+3	3+4	4+4	4+5	5+5	6+5	6+6
		2+1	1+3	3+2	2+4	4+3	3+5	5+4	4+6	5+6	
			3+1	1+4	4+2	2+5	5+3	3+6	6+4		
				4+1	1+5	5+2	2+6	6+3			
					5+1	1+6	6+2				
						6+1					

Is there any sums that we can get in more different ways than 7? It looks like no. Maybe this is why 7 came out the most when we threw 2 dice?

Let's look back at our 6x6 addition table and count how many times we wrote each of the possible sums. We have an entire diagonal of 7s, and single cases of 2 and 12 each. We had the number of different ways of getting the sums in our addition table all along! And the count of which sum showed up how many times, does seem to be the same as the count of each sum in addition table.

We will now play "Free the animals" game. Each person will free animals from cages. Each pair of students will share a field and compete against each other:

First we will play with one dice:

- You will have one dice, one field with 6 cages and each of you will have 6 animals
- before we start, everyone puts their 6 animals into any combination of the 6 cages on the table.
- Then we will take turns throwing dice to decide from which cage we can free our animal.
- Remember:
    - You can free only one animal from the cage with the number that dice throw shows.
    - And you can free your animal from the cage only on your turn!
    - Whoever frees his 6 animals from the cages first wins the game!

What is the better strategy to put your 6 animals?

Then we will play the same game but with 2 dice and 12 cages. This time each of you will have 8 animals to put in cages and will free the animal from the cage that is sum of two dice. Should we change the strategy? Where should we put our animals?

See you next week!