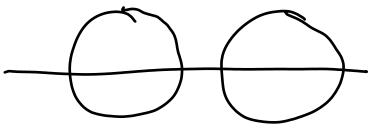
Combinatorial Candy Counting Craziness — Fargo Library Pop-Up STEM Museum

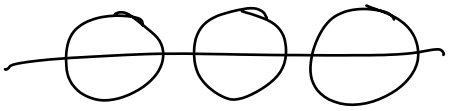
Dr. Jessica Striker - NDSU — July 30, 2014

1. Open your bag of M&Ms. Pick out 1 red and 1 orange M&M. How many different ways are there to line up these 2 M&Ms?



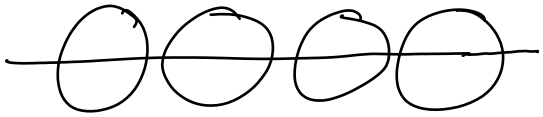
2. Pick out 1 red, 1 orange, and 1 yellow M&M. Write down all the different ways to line up these 3 M&Ms:

   R Y O,



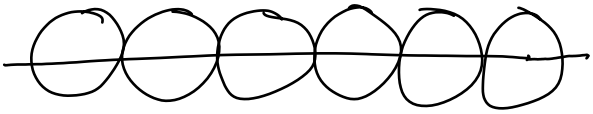
3. Now add 1 green M&M. Now how many ways are there to line up the 4 M&Ms?

   (Hint: How many choices do you have for the first M&M? How many M&Ms do you have left after that?)



4. Add 1 blue and 1 brown M&M. In how many ways can you line up all 6 M&Ms?

   (Hint: There are WAY too many to list!)



5. Do you see a pattern? Can you figure out how many ways there are to line up 100 distinctly colored M&Ms? (You need to imagine that there are 100 different colors of M&Ms!)

6. Suppose you have n distinctly colored M&Ms. How many ways are there to line them up?

You have just discovered the formula for the number of **permutations** of n things! We have a special symbol for this, called the **factorial**:

$$n! = n \times (n-1) \times (n-2) \times \cdots \times 3 \times 2 \times 1.$$

When writing down permutations, we usually use the numbers $1, 2, \ldots, n$ instead of colored M&Ms (even though M&Ms are tastier). So we write all the permutations of 3 things as:

$$123, 132, 213, 231, 312, 321.$$

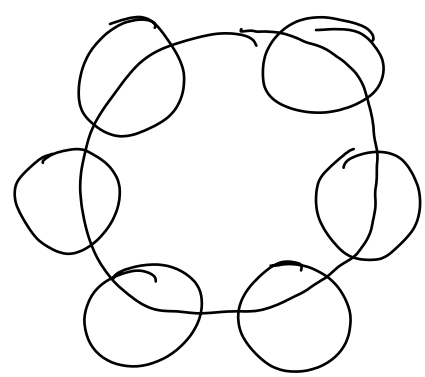
Permutations are used in the mathematical areas of abstract algebra, group theory, and combinatorics, as well as in coding/code-breaking and computing!

Bonus questions:

7. How many ways are there to line up 2 red M&Ms and 1 orange M&M? (Suppose the two red M&Ms are indistinguishable.)

8. How many ways are there to line up 3 red M&Ms, 4 blue M&Ms, 1 orange M&M and 1 green M&M?

9. How many ways are there to arrange 6 distinctly colored M&Ms on a *spinning circle*?



10. In how many ways can you make your M&Ms disappear?