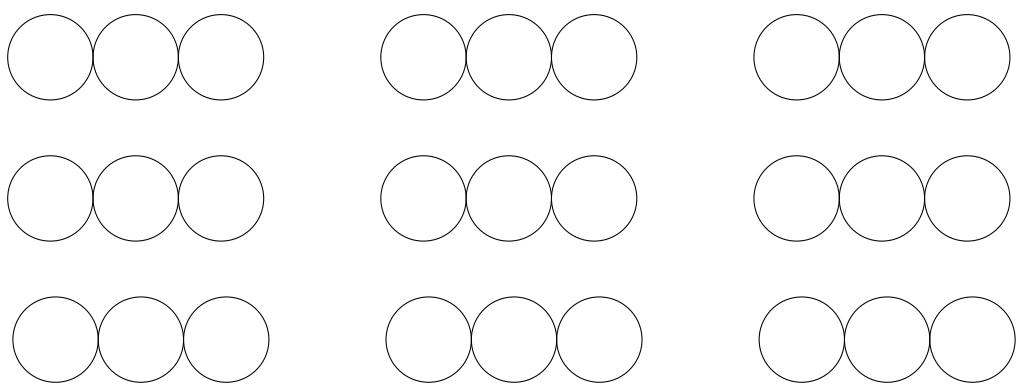
Combinatorial Counting Craziness
NDSU Mathematics

1. Pick out red and blue crayons. How many different ways are there to color 2 circles if you can only use each color once?

2. Pick out red, blue, and green crayons. How many different ways are there to color 3 circles if you can only use each color once?



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

$$5! = 5 \times 4 \times 3 \times 2 \times 1$$

When writing down permutations, we usually use numbers instead of colors. 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!

3. Pick out red, blue, green, and yellow crayons. How many different ways are there to color the 4 circles if you can only use each color once?