

Math Tips: Combinations and Permutations

Key Terms:

A **combination** is a selection of X objects from a set of N objects. The order in which the objects are listed does not matter. For example, suppose you have **3 circles of different colors**, like this:



From this set, there are only **3 possible combinations** of 2 differently colored circles:



Note that **order does not matter** here. **Combinations** just refer to what's in your hand or pocket, so "blue and pink" is just the same as "pink and blue."

Fun Fact: When you're picking **2** items from a set of n , the total **number of possible combinations** will be $1 + 2 + 3 + 4 \dots$ up to 1 less than n . In other words, you'll get our friends the **triangle numbers!** Why? Because out of, say, 7 items, the 1st item can combine with any of them except itself, or 6 choices. The 2nd item then has 5 choices, because it already paired with the 1st item. For the same reason, the 3rd item has just 4 choices...so the total number of combinations ends up being $6 + 5 + 4 + 3 + 2 + 1$.

A **permutation** is a way of putting X objects in a particular order. (**Permutations are particular!**) For example, if you have these 3 letters:



you can use them to create **6 possible Permutations:**

E A R	A E R	R A E
E R A	A R E	R E A

Unlike combinations, **order matters for permutations**, so "E-A-R" is counted separately from "E-R-A." That means you have 3 choices for the first slot, then for each of those you have 2 choices for the 2nd slot - because you've already pulled a letter out of the pile. This leaves you only one choice for the final slot, so the **total number of permutations** is $3 \times 2 \times 1 = 6$.