# 13.3 Permutations and Combinations

*Learning Targets for today*

- To be able to use combinations to solve problems.
- To be able to use permutations to solve problems.

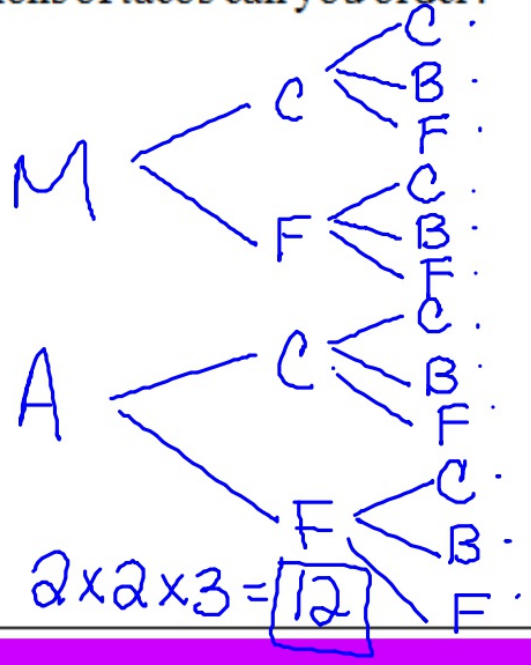
***Key Concepts***

**Fundamental Counting Principal** – describes the method of multiplication to count.

Ex: *2 shirts and 4 pants give 2 * 4 = 8 possible options for an outfit*

*Using the Fundamental Counting Principal*

| **Example for you…** | **Your turn to try…** |
|---|---|
| *Answer the question by drawing an illustration.* | *Answer the question by drawing an illustration.* |
| 1. Arturo's Tacos give you the option of a Mexican or American taco made with either a corn or flour tortillas, with your choice of chicken, beef, or fish. How many different options of tacos can you order? | 2. Your parents are buying you're a new car. They want to buy you a truck, SUV, or sedan that is either red, black, gold, or green. You also much decide whether you would like leather or cloth seats. How many different options do you have in your car selection? |




Type = 3
Color = 4
Interior = 2

3x4x2 = 24 options

***Key Concepts***

**Permutation** – An arrangement of items in particular order. **ORDER MATTERS!**

Ex: *You want to file 4 folders in a cabinet.* There are 4 ways to select the first folder, 3 ways to select the second folder, 2 ways to select the third folder, and 1 way to select that last…


* You would solve this using a **factorial.**

* Which in this case would be **4!** = **4 · 3 · 2 · 1**

***Special Notes on Factorials*: n! = n(n-1)(n-2)… and 0! = 1**

*Working with Permutations*

| **Example for you…** | **Your turn to try…** |
| --- | --- |
| 1. How many different ways can you arrange 6 pairs of pants in a closet?<br>$6! = 720$ | 1. How many different ways can you stack 5 colored toy blocks?<br>$5! = 120$ |

***Number of Permutations***

**The number of permutations of *n* items of a set arranged *r* items at a time is…**

$$_nP_r = \frac{n!}{(n-r)!}$$

***Number of Permutations***

**The number of permutations of *n* items of a set arranged *r* items at a time is…**

$$_nP_r = \frac{n!}{(n-r)!}$$

*Finding* $_nP_r$

| **Example for you…** | **Your turn to try…** |
|---|---|
| 1. How many different ways can 12 runner's place 1st, 2nd, or 3rd place in a 10k road race? | 1. How many different ways can 25 students get on the list for surprise pizza party lunch that only allows ~~10~~ 5 kids total to be a part of? |
| $_{12}P_3 = \frac{12!}{(12-3)!} = \frac{12!}{9!} = \frac{12 \cdot 11 \cdot 10 \cdot 9!}{9!}$ <br> $= 1{,}320$ | $_{25}P_5 = 6{,}375{,}600$ |

## *Number of Combinations*

**The number of combinations of *n* items of a set arranged *r* items at a time is…**

$$_nC_r = \frac{n!}{r!(n-r)!}$$

* Combination is used when the **ORDER DOES NOT MATTER** in which the events take place!

*Finding* $_nC_r$

| **Example for you…** | **Your turn to try…** |
|---|---|
| 1. A standard deck of playing cards is being used to deal 5-card hands. If the order does not matter, how many different sets of 5-card hands are possible for you to be dealt? | 1. You are picking 3 classes from a total of 57 classes off the course registration guide for next year? How many different combinations of classes could you have to take next year? |
| $_{52}C_5 = 2,598,960$ | $_{57}C_3 = 29,260$ |

*Combination or Permutation?*

| **Example for you…** | **Your turn to try…** ways |
|---|---|
| 1. Mrs. Gervais selects 6 students to show their answer to problems from the CH 10 Review on the board. If there are 24 students in the classroom, how many different ways can she select students from her class to share their answers?<br><br>$_{24}C_{6} = 134,596$ | 1. How many ~~different order~~ can you choose to read 6 out of 10 books you hope to read this summer?<br><br>$_{10}P_{6} = 151,200$ |