Name _____ Class _____ Date _____

Reteaching: Section 14-3

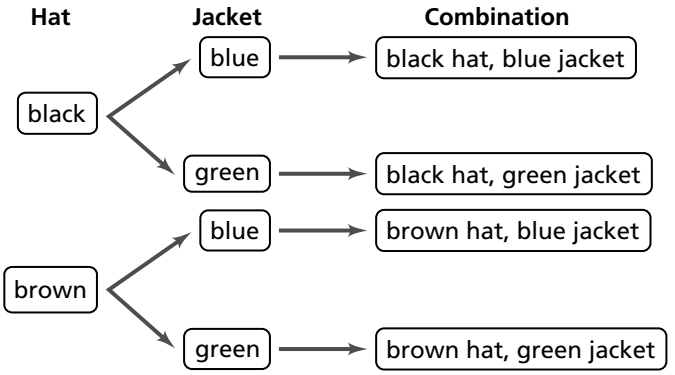
Permutations and Combinations

Fundamental Counting Principle

You have 2 different hats, black and brown. You have 2 different jackets, blue and green. How many combinations of the two can you make?

A tree diagram is often used to represent all possible ways to choose objects from different sets.

The tree diagram below shows the number of combinations for 2 hats and 2 jackets.



An easier way to determine the number is to multiply the number of each option using the *Fundamental Counting Principle*. There are 2 types of hats and 2 types of jackets, so $2 \cdot 2 = 4$ combinations.

Permutations

A car dealer has 3 cars to display in the showroom. In how many ways can he arrange them in a line in the showroom?

When order matters, the arrangement is called a *permutation*.

In this example, there are 3 cars available for the first position. Once the first car is in place, there are 2 cars remaining to choose for the second position. Once the second car is in place, there is only one car left for the third position. Mathematically, the number of possibilities is $3 \cdot 2 \cdot 1 = 6$. This can also be represented as 3 *factorial*, which is written as 3!.

If you have more items to choose from than you need for a permutation, you use this special formula:

$$_{n}\mathrm{P}_{r} = \frac{n!}{(n-r)!}$$

where n is the number of items in the larger group, and r is the number of items in the permutation.

A car dealer has 5 cars from which to choose 3 cars to display in the showroom. In how many ways can he choose 3 cars and arrange them in a line in the showroom?

$$_{5}\mathrm{P}_{3} = \frac{5!}{(5-3)!} = \frac{5!}{2!} = \frac{5 \cdot 4 \cdot 3 \cdot \cancel{2 \cdot 1}}{\cancel{2 \cdot 1}} = \frac{60}{1} = 60 \text{ permutations}$$

Name _____ Class _____ Date _____

Reteaching (continued)

Permutations and Combinations

Combinations

You have 6 sweatshirts from which to choose 2 sweatshirts to take on a camping trip. In how many ways can you choose 2 sweatshirts?

When order does not matter, the arrangement is called a *combination*.

When you choose r items from a group of n items, you find the number of combinations with this formula:

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

How many combinations of 2 sweatshirts can you choose for your camping trip?

$$_{6}C_{2} = \frac{6!}{2!(6-2)!} = \frac{6!}{2! \cdot 4!} = \frac{6 \cdot 5 \cdot \cancel{4!}}{2! \cdot \cancel{4!}} = \frac{30}{2} = 15 \text{ combinations}$$

Exercises

1. A sandwich shop offers 3 types of bread, 2 kinds of cheese, and 5 deli meats. You can choose one type of bread, one kind of cheese, and one deli meat. How many different sandwiches can you order?

For Exercises 2–4, evaluate the permutation.

2. $_{4}P_{2}$
3. $_{5}P_{2}$
4. $_{9}P_{4}$

5. In how many ways can you order 6 objects?

6. There are 5 runners in a race. In how many possible ways can the runners finish first, second, and third?

For Exercises 7–9, evaluate the combinations.

7. $_{4}C_{2}$
8. $_{4}C_{3}$
9. $_{9}C_{7}$

10. How many combinations of 3 objects are possible out of a group of 7 objects?

11. A runner has 8 pairs of running shoes. How many combinations of 4 pairs of shoes can she make?