Probability of a Single Event

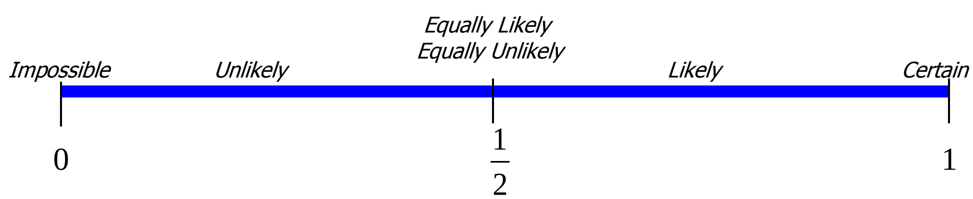
Probability is the chance that an event will occur. Weather predictions are based on probability. The weatherman might say, "There is an 80 percent chance of rain in the afternoon."

We often describe the probability of something happening with words like **impossible**, **unlikely**, **as likely as unlikely**, **equally likely**, **likely**, and **certain.**

The probability of an **event** occurring is represented by a **ratio**. A ratio is a number that is between 0 and 1 and can include 0 and 1.

An event is **impossible** if it has a probability of 0. Having 13 months in a year has the probability of 0.

An event is **certain** if it has the probability of 1. The probability that the sun will rise tomorrow morning is 1.



In math, we conduct **experiments** to test probability and show how it works. The easiest experiment is to toss a coin, such as a penny. What is the chance that the coin will land heads up?

It only has two possibilities: heads or tails. So, the **probability** that heads will occur is one out of two possibilities. These possibilities are called **outcomes**. In this case, both outcomes are **equally likely** or **equally *un*likely**.

OR

Probability = $\frac{1}{2}$ *equally likely* or *equally unlikely*.

By representing probability in fraction form, $\frac{1}{2}$, we are saying there are 1 out of 2 chances that the coin will be tails or 1 out of 2 chances that the coin will be heads.

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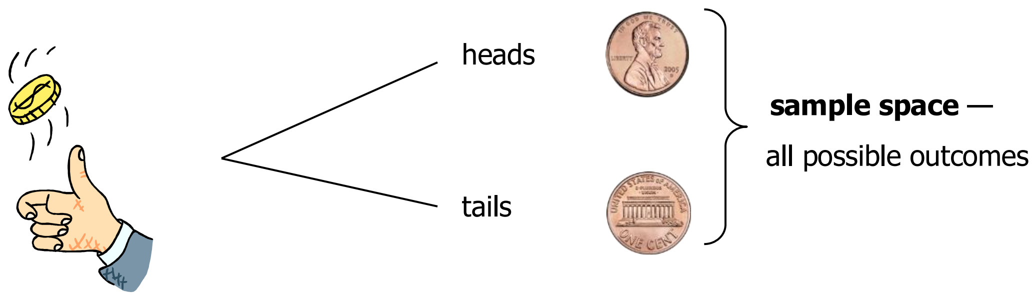
A **sample space** represents all the possible outcomes of an experiment. A **tree diagram** is a good way to represent the outcomes. We can also organize the outcomes in a list or chart. A tree diagram is drawn to show all the possible combinations or outcomes in a sample space. Let's look at a very simple tree diagram for a coin toss.



There are only 2 possible outcomes.

The probability of an event occurring, like heads in a coin toss, is the ratio or comparison of desired outcomes to the total number of possible outcomes. If all the outcomes of an event are **equally likely** to occur, the probability of the event happening is:

$$\textbf{Event} = \frac{\textbf{number of favorable outcomes}}{\textbf{total number of possible outcomes}}$$

So, tossing heads in probability terms would be: **Probability (heads) =** $\frac{1}{2}$

If the probability is not 0 or 1, the probability is expressed in a fraction.

By representing probability in fraction form, such as $\frac{1}{2}$, we are saying there are 1 out of 2 chances that the coin will be tails or 1 out of 2 chances that the coin will be heads.

Mathematicians have discovered that if a probability experiment has only a few trials, such as tossing a coin only four times, the results can be misleading. If we only tossed the coin four times, we could end up with heads on all four tosses instead of just two. If, however, we toss the coin 100 times, it is more likely that we will have heads occurring 50 times.

In other words, the more times an experiment is done, the closer the **experimental probability** comes to the probability we figured out mathematically (**theoretical probability**).

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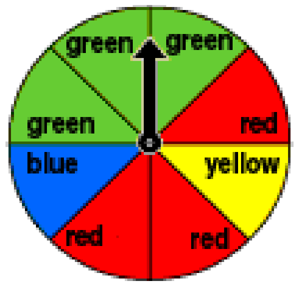
Example:

Let's use a spinner with eight equal sections: three are red, three are green, one is yellow, and one is blue.

What is the **probability** that the spinner will land on green? **The probability will be the number of favorable outcomes (green) over the number of possible outcomes (all the colors).** So there are 3 chances to land on green out of 8 chances altogether.



The statement, "What is the probability that the spinner will land on green?" is called a **problem statement**. This problem statement is asking, "What is the chance of landing on green when we spin the spinner?"

We use the letter ***P*** to indicate the **probability** of the event. The event is indicated by the word in parentheses. In this problem, the color **green** is in parenthesis.

Finding the **probability** looks like this: $\boldsymbol{P}\text{(green)} = \frac{3}{8}$

PRACTICE!

1. What is the probability of landing on red? P (red) = ?

2. What is the probability of landing on yellow?

3. Which color(s) are we **least likely** to land on? Why?

4. Describe the likelihood of the events occurring. Are we ***equally likely*** or ***equally unlikely*** to land on any of the colors? Which colors are ***more unlikely*** than red or green.

PRACTICE!

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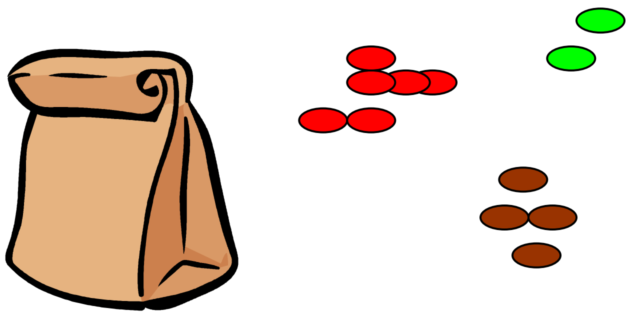
We can do a similar experiment with a bag of M & Ms. Put 12 in a bag: 6 red, 4 brown, and 2 green. The experiment is determining the probability of the color of the candy we might pull out if we reach into the bag without looking. Remember how to write the problem statement based on the number and colors of candies in the bag.



1. What is ***P*** (brown)?

2. What is ***P*** (red)?

3. What is ***P*** (green)?

4. What is ***P*** (green & red)?

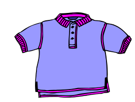
Probability of a Single Event

The **Fundamental Counting Principle** tells us how to find the number of outcomes when there is more than one way to put things together. For example, how many different outfit combinations can we make from 2 shirts (green and blue) and 3 pants (black, white, and brown)?

The **sample space (all possible outcomes)** displayed in the following tree diagram shows that there are 6 outfit combinations: green-black; green-white; green-brown; blue-black; blue-white; blue-brown.

We count **6 outcomes**, but we can also multiply the number of choices by each other to get the counting total, 2 x 3 = 6.

Shirts	**Pants**	**Outcome**
Green	Black	Green-black
	White	Green-white
	Brown	Green-brown
Blue	Black	Blue-black
	White	Blue-white
	Brown	Blue-brown



Number of choices for shirts		**Number of choices for pants**		**Number of possible outcomes**
↓		↓		↓
2	**x**	**3**	**=**	**6**

We can see that there are 6 **possible outcomes** in this experiment.

PRACTICE!

Solve the following problem using a **tree diagram**.

1. Hannah found a Barbie doll website that allowed her to choose the color of Barbie's eyes and hair. How many different combinations or outcomes are there if the eye color choices are green, blue, and brown and the hair choices are blonde, brown, red, and black?