

Understanding Probability

UNDERSTAND Sometimes, more than one outcome is possible for an event. If so, then the likelihood that a particular outcome will occur is called its **probability**. Probability can be represented as a number from 0 to 1. If an event is impossible, the probability of it happening is 0. If an event is certain, the probability of it happening is 1. If a probability is near 0, then it is unlikely. If a probability is near 1, then it is likely. A probability of $\frac{1}{2}$ refers to an event that is equally likely to occur or not occur. The ratio of the number of favorable outcomes to the number of possible outcomes is the **theoretical probability** of the event.

Julia has a bag with 15 colored marbles in it. The probability that Julia will draw a red marble from the bag is $\frac{1}{15}$. The probability that she will draw a green marble is $\frac{7}{15}$. Describe each of those outcomes using terms such as impossible, certain, likely, unlikely, or equally likely.

1

Is the probability of drawing a red marble, $\frac{1}{15}$, near 0, $\frac{1}{2}$, or 1?

$$\begin{array}{r} 0.066\dots \\ 15 \overline{)1.000} \\ \underline{-90} \\ 100 \\ \underline{-90} \\ 10 \end{array}$$

The probability is 0.066..., which is close to 0.

- The probability of drawing a red marble is unlikely because it is near 0.

2

Is the probability of drawing a green marble, $\frac{7}{15}$, near 0, $\frac{1}{2}$, or 1?

$$\begin{array}{r} 0.466\dots \\ 15 \overline{)7.000} \\ \underline{-60} \\ 100 \\ \underline{-90} \\ 100 \\ \underline{-90} \\ 10 \end{array}$$

The probability is 0.466..., which is close to 0.5, or $\frac{1}{2}$.

- The probability of drawing a green marble is about equally likely to drawing a marble that is not green, because the probability is near $\frac{1}{2}$.

Connect

You can conduct an experiment to help determine the probability of an event.

Theo spun a quarter on his desk and observed whether it landed heads up or tails up. He did this 50 times and recorded his results in the table.

Spinning a Quarter

	Number of Times
Heads	24
Tails	26
Total Trials	50

Determine the **experimental probability** of each outcome. Then use those experimental probabilities to predict the number of times you would expect the quarter to land heads up and tails up if you performed this experiment 80 times.

1

Find the experimental probability of the quarter landing heads up.

$$\text{experimental probability} = \frac{\text{number of times event occurs}}{\text{total number of trials}} = \frac{24}{50} = \frac{12}{25} = 0.48 = 48\%$$

2

Find the experimental probability of the quarter landing tails up.

$$\text{experimental probability} = \frac{\text{number of times event occurs}}{\text{total number of trials}} = \frac{26}{50} = \frac{13}{25} = 0.52 = 52\%$$

3

Predict the number of times you would expect the quarter to land heads up and tails up if you performed this experiment 80 times.

Multiply either the fractional probability or the decimal probability by 80.

$$\text{Heads: } 80 \cdot 0.48 = 38.4 \approx 38 \text{ times} \quad \text{Tails: } 80 \cdot 0.52 = 41.6 \approx 42 \text{ times}$$

► A good prediction would be that the quarter will land heads up 38 times and tails up 42 times. Since those numbers are so close, you could also predict that it would land heads up about $\frac{1}{2}$ the time (40 times) and tails up $\frac{1}{2}$ the time (40 times).

TRY

Cynthia drew a tile from a bag, recorded its color, and replaced it in the bag. The table shows her results.

If there are a total of 35 tiles in the bag, predict how many are silver.

Drawing Tiles

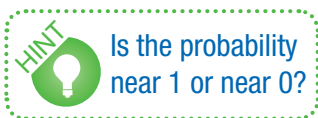
	Number of Times
Black	24
Silver	36
Total Trials	60

Practice

Identify each event as *impossible*, *likely*, *unlikely*, or *certain*.

1. The probability of tossing a number cube and getting 5 is $\frac{1}{6}$.

2. The probability of spinning blue on a spinner is 0.



Fill in the blanks.

3. _____ can be expressed as a number from 0 to 1 and is the likelihood that an event will occur.

4. The _____ of an event is the ratio of the number of times the event occurs in an experiment to the total number of trials.

5. If two outcomes are _____ likely, they have the same probability.

6. If an outcome is unlikely, it has a probability near _____.

7. If an outcome is likely, it has a probability near _____.

8. The _____ of an event is the ratio of the number of favorable outcomes to the number of possible outcomes.

Describe each event as *likely*, *unlikely*, or *neither likely nor unlikely*. Explain why.

9. The probability of selecting a red marble from a bag of marbles is 0.47.

10. The probability of selecting a tile with a vowel on it from a box of tiles is $\frac{3}{20}$.

11. The probability of a spinner landing on a shaded section is 53%.

12. The probability of tossing a number cube and rolling a number greater than 1 is $\frac{5}{6}$.

The table below on the right shows the results of choosing a tile from a bag with lettered tiles in it. Use the table for questions 13 and 14. Show your work for each question.

13. What is the experimental probability of randomly selecting the letter A from the bag? the letter B? Simplify answers if possible.

Drawing Tiles from Bag

	Number of Times
A	8
B	16
Total Trials	24

14. If there are a total of 9 tiles in the bag, predict how many of the tiles in the bag have the letter B on them.

Solve. Assume that questions 15 and 16 involve the same spinner.

15. **PREDICT** The table shows the results of spinning a spinner 10 times. If you spin this spinner 40 times, predict how many times the spinner will land on a yellow section. Show your work and explain why your prediction may not be completely accurate.

Spinning a Spinner

	Number of Times
Blue	2
Orange	5
Yellow	3
Total Trials	10

16. **COMPARE** The table shows the results of spinning the same spinner 300 times. Compare the experimental probabilities for the two experiments. Which experimental probabilities give better estimates of the probability of spinning each color? Explain.

Spinning a Spinner

	Number of Times
Blue	75
Orange	150
Yellow	75
Total Trials	300
