Experimental and Theoretical Probability
10.3

- When you conduct an experiment, the **relative frequency** of an event is the fraction or percent of the time that the event occurs.

- For example –
  - Work with the person next to you. One will flip a penny 10 times and the other will record the results. Then complete the table. Then have your partner flip the penny 10 times and you record the results. The complete the table.
  - Compare your results.

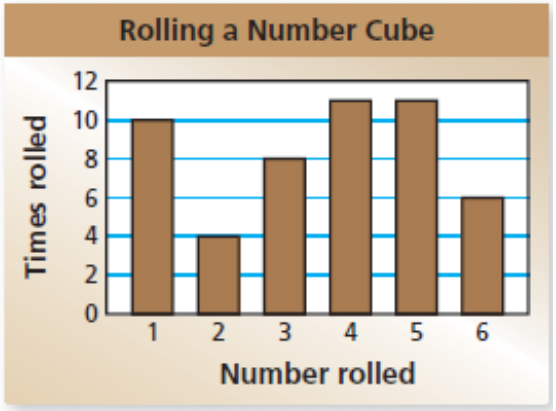
	Flipping Heads	Flipping Tails
Relative Frequency		

Experimental Probability

- Probability that is based on repeated trials of an experiment is called **experimental probability.**
- The experimental probability of an event is written as a ratio:

$$P(event) = \frac{number\ of\ times\ the\ event\ occurs}{total\ number\ trials}$$

EXAMPLE 1 Finding an Experimental Probability



The bar graph shows the results of rolling a number cube 50 times. What is the experimental probability of rolling an odd number?

The bar graph shows 10 ones, 8 threes, and 11 fives. So, an odd number was rolled $10 + 8 + 11 = 29$ times in a total of 50 rolls.

$$P(\text{event}) = \frac{\text{number of times the event occurs}}{\text{total number of trials}}$$

$$P(\text{odd}) = \frac{29}{50}$$

← An odd number was rolled 29 times.

← There was a total of 50 rolls.

The experimental probability is $\frac{29}{50}$, 0.58, or 58%.

EXAMPLE 2 Making a Prediction

"April showers bring May flowers." Old Proverb, 1557

It rains 2 out of the last 12 days in March. If this trend continues, how many rainy days would you expect in April?

Find the experimental probability of a rainy day.

$$P(\text{event}) = \frac{\text{number of times the event occurs}}{\text{total number of trials}}$$

$$P(\text{rain}) = \frac{2}{12} = \frac{1}{6}$$

It rains 2 days.

There is a total of 12 days.

To make a prediction, multiply the probability of a rainy day by the number of days in April.

$$\frac{1}{6} \cdot 30 = 5$$

So, you can predict that there will be 5 rainy days in April.

EXAMPLE 3 Finding a Theoretical Probability

- Theoretical Probability is what you learned in 10.2 and can be found using the following ratio:

$$P(event) = \frac{number\ of\ favorable\ outcomes}{total\ number\ possible\ outcomes}$$

- Example

Each letter of the word PROBABLE is written on a separate card. The cards are placed face down and mixed up. What is the probability that a randomly selected card has a consonant?

There are 8 possible outcomes and 5 favorable outcomes.

$$P(\text{consonant}) = \frac{5}{8} = 62.5\%$$

EXAMPLE 4 Using a Theoretical Probability

The theoretical probability of winning a bobblehead when spinning a prize wheel is $\frac{1}{6}$. The wheel has 3 bobblehead sections. How many sections are on the wheel?

$$P(\text{bobblehead}) = \frac{\text{number of bobblehead sections}}{\text{total number of sections}}$$

We can write a proportion to solve this problem.

$\frac{1}{6} = \frac{3}{n}$ Let n be the number of sections on the wheel.

$n = 18$ Use cross products.

There are 18 sections on the wheel.

Contrast experimental and theoretical probability

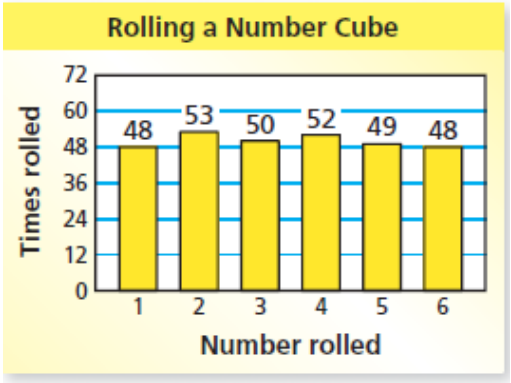
Experimental probability is the result of an experiment.

Theoretical probability is what is expected to happen.

EXAMPLE 5 Comparing Experimental and Theoretical Probability

The bar graph shows the results of rolling a number cube 300 times.

a. What is the experimental probability of rolling an odd number?



The bar graph shows 48 ones, 50 threes, and 49 fives. So, an odd number was rolled 48 + 50 + 49 = 147 times in a total of 300 rolls.

$$P(\text{event}) = \frac{\text{number of times the event occurs}}{\text{total number of trials}}$$

$$P(\text{odd}) = \frac{147}{300}$$

An odd number was rolled 147 times.

There was a total of 300 rolls.

$$= \frac{49}{100}, \text{ or } 49\%$$

b. How does the experimental probability compare with the theoretical probability of rolling an odd number?

It's close to Theoretical Probability of 50%