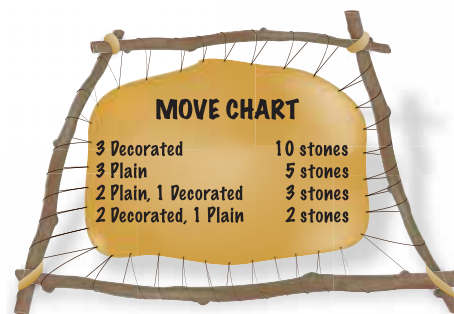# 9.3 Experimental Probability

Essential Question What is meant by experimental probability?

1 ACTIVITY: Throwing Sticks

Play with a partner. This game is based on an Apache game called "Throw Sticks."

- Take turns throwing three sticks into the center of the circle and moving around the circle according to the chart.
- If your opponent lands on or passes your playing piece, you must start over.
- The first player to pass his or her starting point wins.

MOVE CHART

3 Decorated	10 stones
3 Plain	5 stones
2 Plain, 1 Decorated	3 stones
2 Decorated, 1 Plain	2 stones

Each stick has one plain side and one decorated side.
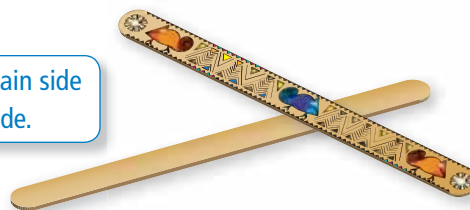
The game board has 40 stones arranged in a circle. The stones are placed in groups of 10.

Players start on opposite sides of the circle.

Player 1 Starting Point

Player 2 Starting Point

2 ACTIVITY: Conducting an Experiment

Work with a partner. Throw the 3 sticks 32 times. Tally the results using the outcomes listed below. Organize the results in a bar graph. Use the bar graph to estimate the probability of each outcome. These are called <mark>experimental probabilities</mark>.
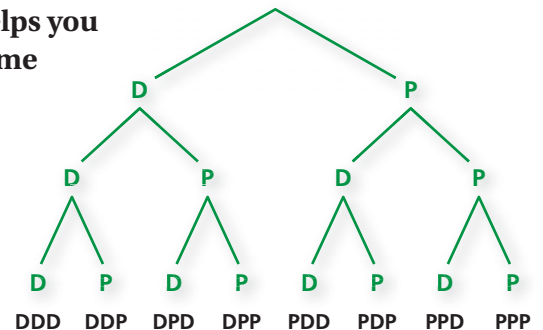
a. PPP

b. DPP

c. DDP

d. DDD

3 ACTIVITY: Analyzing the Possibilities

Work with a partner. A tree diagram helps you see different ways that the same outcome can occur.

a. Find the number of ways that each outcome can occur.

- Three Ps
- One D and two Ps
- Two Ds and one P
- Three Ds


```
            D                    P
          /   \                /   \
         D     P              D     P
        / \   / \            / \   / \
       D   P D   P          D   P D   P
      DDD DDP DPD DPP      PDD PDP PPD PPP
```

b. Find the theoretical probability of each outcome.

c. Compare and contrast your experimental and theoretical probabilities.

What Is Your Answer?

4. **IN YOUR OWN WORDS** What is meant by experimental probability?

5. Give a real-life example of experimental probability.

Practice Use what you learned about experimental probability to complete Exercises 3–6 on page 402.

Key Vocabulary 🔊
experimental
  probability, *p. 400*

🔑 Key Idea

Experimental Probability
Probability that is based on repeated trials of an experiment is called
experimental probability.

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

EXAMPLE ① **Standardized Test Practice**

**Thirteen out of 20 emails in your inbox are junk emails. What is the
experimental probability that your next email is junk?**

(A) 35%   (B) 45%   (C) 55%   (D) 65%

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

$$P(\text{junk}) = \frac{13}{20}$$

> You have 13 emails that are junk.
> You have a total of 20 emails.

∴ The probability is $\frac{13}{20}$, 0.65, or 65%. The correct answer is (D).

EXAMPLE ② **Making a Prediction**

**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.

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

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

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

∴ You can predict that there will be 5 rainy days in April.

🔊 *Multi-Language Glossary at BigIdeasMath⌄com.*

1. In Example 1, what is the experimental probability that your next email is *not* junk?

2. At a clothing company, an inspector finds 5 defective pairs in a shipment of 200 jeans.

   a. What is the experimental probability of a pair of jeans being defective?

   b. About how many would you expect to be defective in a shipment of 5000 pairs of jeans?
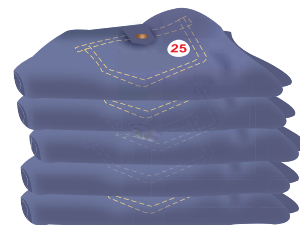
EXAMPLE 3 Comparing Experimental and Theoretical Probabilities

Rolling a Number Cube
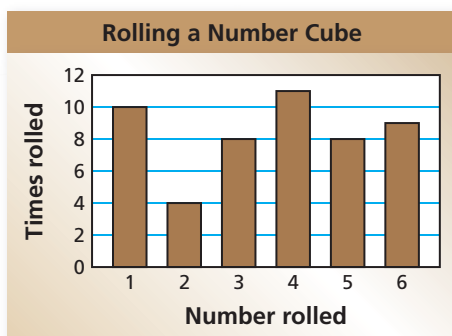
The bar graph shows the results of rolling a number cube 50 times. What is the experimental probability of rolling an odd number? How does this compare with the theoretical probability of rolling an odd number?

Find the experimental probability of rolling a 1, 3, or 5.

The bar graph shows 10 ones, 8 threes, and 8 fives. So, an odd number was rolled $10 + 8 + 8 = 26$ times in a total of 50 rolls.

Experimental Probability

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

$$P(\text{odd}) = \frac{26}{50}$$

An odd number was rolled 26 times.

There was a total of 50 rolls.

$$= \frac{13}{25}$$

Theoretical Probability

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

$$P(\text{odd}) = \frac{3}{6}$$

There are 3 odd numbers.

There is a total of 6 numbers.

$$= \frac{1}{2}$$

∴ The experimental probability is $\frac{13}{25} = 0.52 = 52\%$. The theoretical probability is $\frac{1}{2} = 0.5 = 50\%$. The experimental and theoretical probabilities are similar.

On Your Own

3. In Example 3, what is the experimental probability of rolling a number greater than 1? How does this compare with the theoretical probability of rolling a number greater than 1?

✓ Vocabulary and Concept Check

1. **VOCABULARY** Describe how to find the experimental probability of an event.

2. **REASONING** You flip a coin 10 times and find the experimental probability of flipping tails to be 0.7. Does this seem reasonable? Explain.

Practice and Problem Solving

You have three sticks. Each stick has one red side and one blue side. You throw the sticks 10 times and record the results. Use the table to find the experimental probability of the event.

Outcome	Frequency
3 red	4
3 blue	0
2 blue, 1 red	2
2 red, 1 blue	4

3. Tossing 3 red

4. Tossing 2 blue, 1 red

5. Tossing 2 red, 1 blue

6. *Not* tossing all red

Use the bar graph to find the experimental probability of the event.

1️⃣ 7. Spinning a 6

8. Spinning an even number

9. *Not* spinning a 1

10. Spinning a number less than 3

11. Spinning a 1 or a 3

12. Spinning a 7

Spinning a Spinner
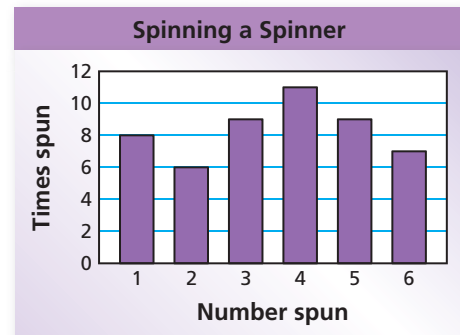
13. **ERROR ANALYSIS** Describe and correct the error in finding $P(4)$ using the bar graph.

✗ $P(4) = \dfrac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \dfrac{1}{6}$

14. **EGGS** You check 20 cartons of eggs. Three of the cartons have at least one cracked egg. What is the experimental probability that a carton of eggs has at least one cracked egg?

2️⃣ 15. **BOARD GAME** There are 105 lettered tiles in a board game. You choose the tiles shown. How many of the 105 tiles would you expect to be vowels?

16. **CARDS** You have a package of 20 assorted thank-you cards. You pick the four cards shown. How many of the 20 cards would you expect to have flowers on them?

17. **QUALITY CONTROL** An inspector estimates that $\frac{1}{2}$% of MP3 players are defective. In a shipment of 5000 MP3 players, predict the number that are defective.

18. **MUSIC** During a 24-hour period, the ratio of pop songs played to rap songs played on a radio station is 60 : 75.

   a. What is the experimental probability that the next song played is rap?
   b. Out of the next 90 songs, how many would you expect to be pop?

③ 19. **FLIPPING A COIN** You flip a coin 20 times. You flip heads 12 times. Compare your experimental probability of flipping heads with the theoretical probability of flipping heads.

You roll a pair of number cubes 60 times. You record your results in the bar graph shown.
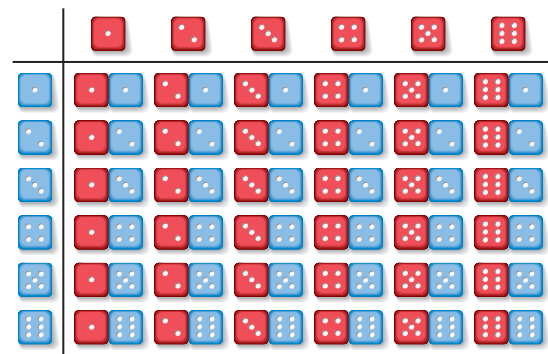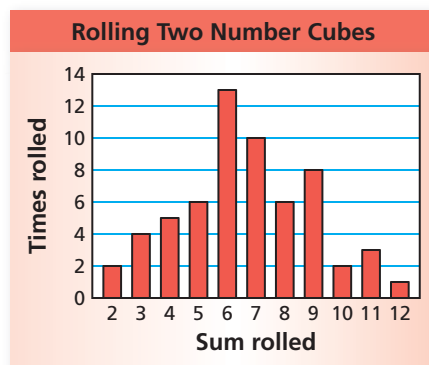
20. Use the bar graph to find the experimental probability of rolling each sum. Which sum is most likely?

21. Use the table to find the theoretical probability of rolling each sum. Which sum is most likely?

22. Compare the probabilities you found in Exercises 20 and 21.

23. **Critical Thinking** You roll two number cubes. Describe and perform an experiment to find the probability that the product of the two numbers rolled is at least 12. How many times did you roll the number cubes?

Fair Game Review What you learned in previous grades & lessons

Solve the equation. *(Section 2.5)*

24. $5x = 100$ 25. $75 = 15x$ 26. $2x = -26$ 27. $-4x = -96$

28. **MULTIPLE CHOICE** What is the least common denominator of the fractions $\frac{1}{16}$, $\frac{2}{19}$, and $\frac{3}{76}$? *(Skills Review Handbook)*

   Ⓐ 16   Ⓑ 76   Ⓒ 304   Ⓓ 1216