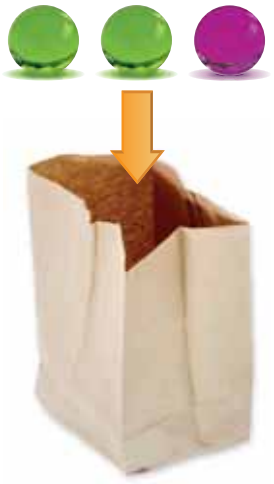
English Spanish

9.4 Independent and Dependent Events

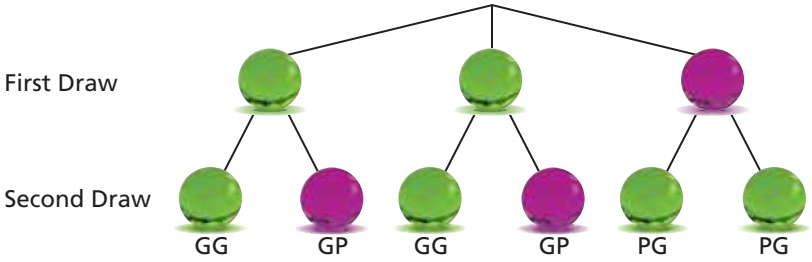
Essential Question What is the difference between dependent and independent events?

1 ACTIVITY: Dependent Events

Work with a partner. You have three marbles in a bag. There are two green marbles and one purple marble. You randomly draw two marbles from the bag.



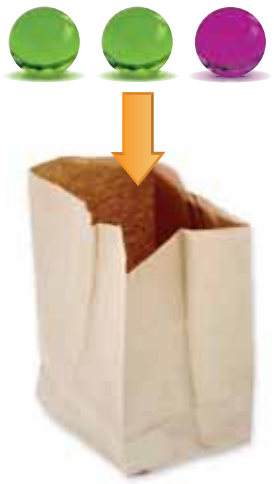
a. Use the tree diagram to find the probability that both marbles are green.



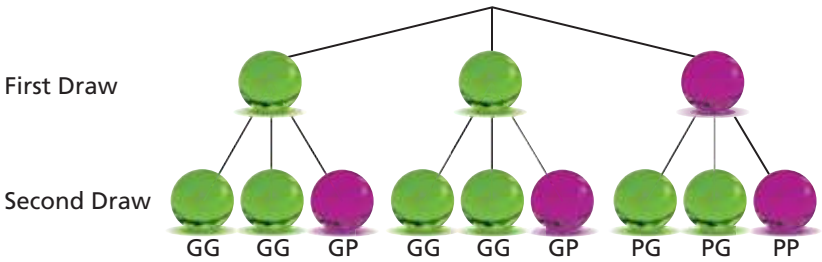
b. In the tree diagram, does the probability of getting a green marble on the second draw *depend* on the color of the first marble? Explain.

2 ACTIVITY: Independent Events

Work with a partner. Using the same marbles from Activity 1, randomly draw a marble from the bag. Then put the marble back in the bag and draw a second marble.



a. Use the tree diagram to find the probability that both marbles are green.



b. In the tree diagram, does the probability of getting a green marble on the second draw *depend* on the color of the first marble? Explain.

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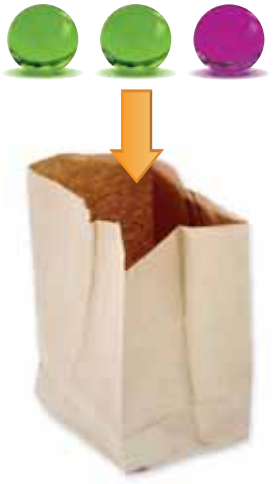
3 ACTIVITY: Conducting an Experiment

Work with a partner. Conduct two experiments.



a. In the first experiment, randomly draw two marbles from the bag 36 times. Record each result as GG or GP. Make a bar graph of your results.

b. What is the experimental probability of drawing two green marbles? Does this answer seem reasonable? Explain.

c. In the second experiment, randomly draw one marble from the bag. Put it back. Draw a second marble. Repeat this 36 times. Record each result as GG, GP, or PP. Make a bar graph of your results.

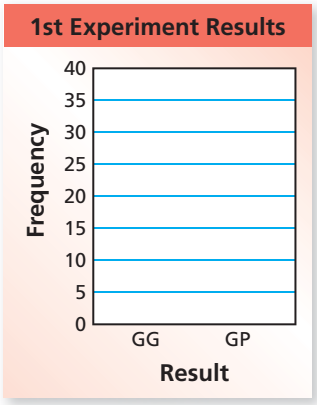
d. What is the experimental probability of drawing two green marbles? Does this answer seem reasonable? Explain.

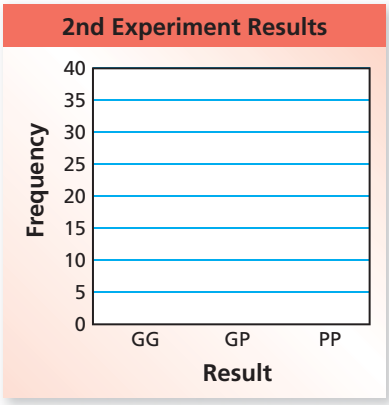
1st Experiment

GG	
GP	

2nd Experiment

GG	
GP	
PP	





What Is Your Answer?

4. IN YOUR OWN WORDS What is the difference between dependent and independent events? Describe a real-life example of each.

Practice Use what you learned about independent and dependent events to complete Exercises 5 and 6 on page 409.

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9.4 Lesson

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Key Vocabulary
independent events, *p. 406*
dependent events, *p. 406*

Two events are **independent events** if the occurrence of one event *does not* affect the likelihood that the other event will occur.

Two events are **dependent events** if the occurrence of one event *does* affect the likelihood that the other event will occur.

EXAMPLE 1 Identifying Independent and Dependent Events

Tell whether the events are *independent* or *dependent*. Explain.

a. You flip heads on one coin and tails on another coin.

The outcome of flipping one coin does not affect the outcome of flipping the other coin.

∴ So, the events are independent.

b. Your teacher chooses one student to lead a group, and then chooses another student to lead another group.

The teacher cannot pick the same student to lead both groups. So, there are fewer students to choose from when the leader of the second group is chosen.

∴ So, the events are dependent.

On Your Own

Now You're Ready
Exercises 5–9

Tell whether the events are *independent* or *dependent*. Explain.

1. You choose a blue marble from a bag and set it aside. Then you choose a green marble from the bag.
2. You roll a 5 on a number cube and spin blue on a spinner.

Key Idea

Probability of Independent Events

Words The probability of two independent events A and B is the probability of A times the probability of B.

Symbols $P(A \text{ and } B) = P(A) \cdot P(B)$

probability of both events

probability of first event

probability of second event

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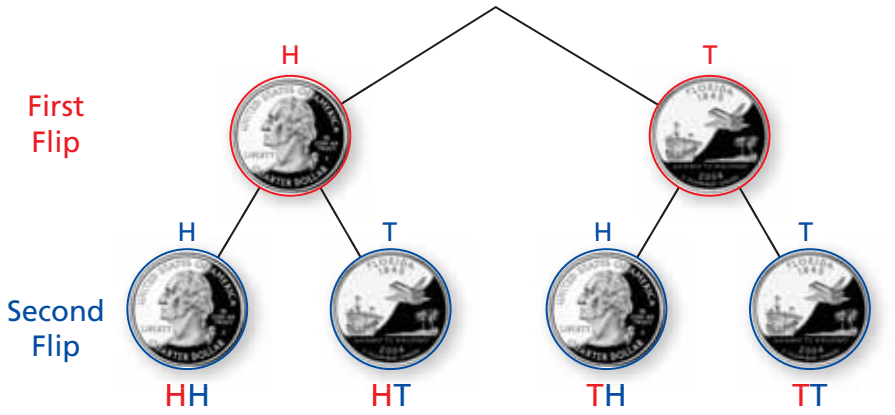
EXAMPLE 2 Finding the Probability of Independent Events

You flip two quarters. What is the probability that you flip two heads?

Method 1: Use a tree diagram to find the probability.

Let H = Heads and T = Tails.



$$P(\text{two heads}) = \frac{\text{number of times two heads occur}}{\text{total number of outcomes}}$$

$$= \frac{1}{4}$$

∴ The probability that you flip two heads is $\frac{1}{4}$.

Method 2: Use the formula for independent events.

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

$$P(\text{heads and heads}) = P(\text{heads}) \cdot P(\text{heads})$$

$$= \frac{1}{2} \cdot \frac{1}{2} \quad \text{Substitute.}$$

$$= \frac{1}{4} \quad \text{Multiply.}$$

∴ The probability that you flip two heads is $\frac{1}{4}$.

On Your Own

Now You're Ready
Exercises 10–18

3. You flip two coins. What is the probability that you flip one heads and one tails?
4. You flip a coin and roll a number cube. What is the probability that you flip tails and roll a number less than 5?

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Key Idea

Probability of Dependent Events

Words The probability of two dependent events A and B is the probability of A times the probability of B after A occurs.

Symbols $P(A \text{ and } B) = P(A) \cdot P(B \text{ after } A)$

probability of both events

probability of first event

probability of second event after first event occurs

EXAMPLE 3 Finding the Probability of Dependent Events

You randomly choose a flower from the vase to take home. Your friend randomly chooses another flower from the vase to take home. What is the probability that you choose a purple flower and your friend chooses a yellow flower?

Purple: 7
Yellow: 9
Pink: 12

Choosing a flower changes the number of flowers left in the vase. So, the events are dependent.

There are 7 purple flowers.

There is a total of 28 flowers.

$$P(\text{first is purple}) = \frac{7}{28} = \frac{1}{4}$$

There are 9 yellow flowers.

There is a total of 27 flowers left.

$$P(\text{second is yellow}) = \frac{9}{27} = \frac{1}{3}$$

Use the formula to find the probability.

$$P(A \text{ and } B) = P(A) \cdot P(B \text{ after } A)$$

$$P(\text{purple and yellow}) = P(\text{purple}) \cdot P(\text{yellow after purple})$$

$$= \frac{1}{4} \cdot \frac{1}{3} \qquad \text{Substitute.}$$

$$= \frac{1}{12} \qquad \text{Simplify.}$$

∴ The probability of choosing a purple flower and then a yellow flower is $\frac{1}{12}$, or about 8%.

On Your Own

Now You're Ready
Exercises 19–25

5. **WHAT IF?** In Example 3, what is the probability that both flowers are purple?

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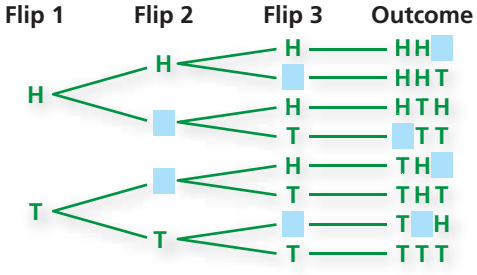
9.4 Exercises

Vocabulary and Concept Check

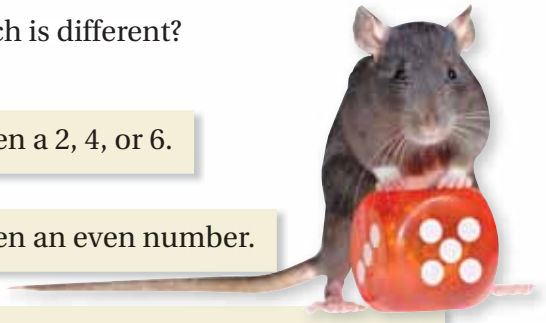
1. **VOCABULARY** Events A and B are independent. Describe two ways to find $P(A \text{ and } B)$.

2. **FILL IN THE BLANKS** Copy and complete the tree diagram to find the possible outcomes for flipping a coin three times.



3. **OPEN-ENDED** Describe a real-life example of two independent events. Describe a real-life example of two dependent events.

4. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.



Find the probability of rolling a 1 and then a 2, 4, or 6.

Find the probability of rolling a 1 and then an even number.

Find the probability of rolling an odd number and then an even number.

Find the probability of rolling a number less than 2 and then an even number.

Practice and Problem Solving

Tell whether the events are *independent* or *dependent*. Explain.

1

5. You roll a number cube twice.

   First Roll: You roll a 4.
   Second Roll: You roll an even number.

6. You flip a coin twice.

   First Flip: Heads
   Second Flip: Heads

7. You randomly draw a marble from a bag containing 2 red marbles and 5 green marbles. You put the marble back and then draw a second marble.

   First Draw: Green Second Draw: Red

8. You randomly draw a marble from a bag containing 2 red marbles and 5 green marbles. You keep the marble and then draw a second marble.

   First Draw: Green Second Draw: Red

9. You and your friend are in a drawing for two door prizes. You can win only one prize.

   First Draw: Your name is drawn. Second Draw: Your friend's name is drawn.

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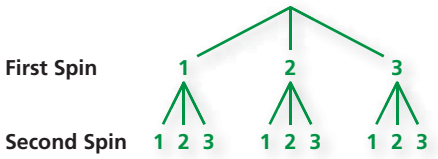
A spinner has three equal sections numbered 1, 2, and 3. You spin it twice. Use the tree diagram to find the probability of the events.



2 **10.** Spinning a 1 and then a 3

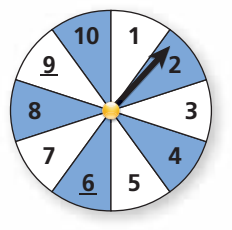
11. Spinning an odd number and then a 2

12. Spinning a 3 and then an even number

13. Spinning an even number and then an odd number

14. Spinning an odd number on each spin

You spin the spinner and flip a coin. Find the probability of the events.



15. Spinning a 4 and flipping heads

16. Spinning an even number and flipping tails

17. Spinning a multiple of 3 and flipping heads

18. Spinning white and *not* flipping tails

You randomly choose one of the lettered tiles. Without replacing the first tile, you choose a second tile. Find the probability of choosing the first tile, then the second tile.

3 **19.** R and N

20. A and L

21. D and O

22. N and yellow

23. O and *not* yellow

24. *Not* O and O

25. If you randomly choose all seven tiles in order, what is the probability that you will spell the name of a popular vacation destination in Florida?

26. **EARRINGS** A jewelry box contains two gold hoop earrings and two silver hoop earrings. You randomly choose two earrings. What is the probability that both are silver hoop earrings?

27. **PASSWORD** You forgot the last two digits of your password for a website.

a. You choose a two-digit number at random. What is the probability that your choice is correct?

b. Suppose you remember that both digits are even numbers. How does this change the probability that your choice is correct?

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28. **FISH** You randomly choose two fish from the bowl. What is the probability that the first is red and the second is gold?

29. **TAKING A TEST** You are guessing at two questions on a multiple choice test. Each question has three choices: A, B, and C.

a. What is the probability that you guess the correct answers to both questions?

b. Suppose you can eliminate one of the choices for each question. How does this change the probability that your guesses are correct?

30. **REASONING** The probability of winning a spelling bee *and* winning a checkers game is 10%. The probability of winning a checkers game is $\frac{1}{2}$. (a) What is the probability of winning a spelling bee? (b) You enter 10 spelling bees. How many do you expect to win?

31. **SHOES** Twenty percent of the shoes manufactured by a company are black. One shoe is chosen and replaced. Then a second shoe is chosen. What is the probability that *neither* shoe is black?

32. Critical Thinking You randomly choose a pair of sunglasses from the shelf below. Then you randomly choose a second pair of sunglasses without replacing the first pair. List all of the possible outcomes.

Blue (B) Green (G) White (W) Green (G) Blue (B)

ODDS **The *odds in favor of* an event is the ratio of the number of favorable outcomes to the number of unfavorable outcomes. The *odds against* an event is the ratio of the number of unfavorable outcomes to the number of favorable outcomes. Find the *odds in favor of* and the *odds against* the event when rolling a number cube.**

33. Rolling a 6

34. Rolling a number less than 5

35. Rolling a 6, then rolling a 3

Fair Game Review What you learned in previous grades & lessons

Solve the equation. SECTION 2.4 SECTION 2.5 SECTION 2.6

36. $6 = 9.3 + x$

37. $\frac{n}{2} = -5.4$

38. $-4p + 6 = -10$

39. **MULTIPLE CHOICE** Which intervals can be used to make a histogram? SECTION 8.2

(A) 16–18, 19–21, 22–26, 27–32

(B) 91–110, 111–130, 131–150

(C) 11–20, 21–40, 41–50, 51–70

(D) 50–60, 60–70, 70–80, 80–90