

11.2

Outcomes of Independent Events

Focus on...

After this lesson, you will be able to...

- determine the outcomes of two or more independent events
- verify the total number of possible outcomes using a different strategy



You make many choices every day. Ethan's decision is simple when he looks at today's cafeteria menu. He loves soup, cheeseburgers, and chocolate milk. But Sarah likes all the items listed on the menu. How many choices does she have? A lunch special consists of one appetizer, one main meal, and one drink. How many different lunch specials can you create for her to choose from?

Explore the Math

How do you determine the total number of possible outcomes?

1. Use a method of your choice to show Sarah's possible choices. You may wish to use abbreviations for the choices, such as CB for cheeseburger.
2. Compare your method of showing Sarah's choices to those of other classmates. What other methods were used? Which method is the most efficient? Justify your choice.
3. How many possible outcomes did Sarah have?

Literacy Link

The order is not important in a combination. For example, (juice, cookie) is the same combination as (cookie, juice).

4. Determine the number of possible outcomes for each combination given in the table.

Number of Choices for Item 1	Number of Choices for Item 2	Number of Choices for Item 3	Outcomes
2 types of ice-cream cones	3 flavours of ice cream	none	
5 shirts	4 pants	none	
5 models of sports cars	3 different colours	none	
4 models of computers	4 models of monitors	none	
3 models of computers	4 models of monitors	2 models of printers	

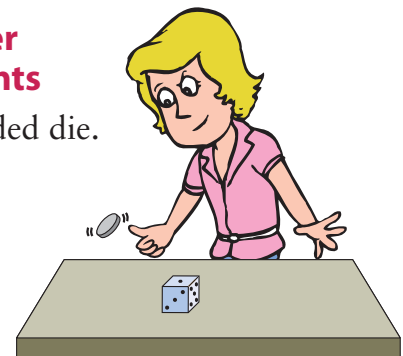
5. Study the numbers in each row of the table, looking for any patterns. How could you calculate the total number of outcomes using the number of choices for each item?

Reflect on Your Findings

6. a) Use your conclusion from #5 to calculate the number of different lunch specials available to Sarah. Explain your reasoning. Compare your result with your answer to #3.
- b) At another school's cafeteria, Martha has two choices of soup, four choices of main dish, two choices of dessert, and three choices of a beverage. Determine the number of possible lunch specials she can choose from. Show that you are correct by using another method.
- c) Suggest a rule for determining the total number of possible outcomes in a series of independent events without creating a tree diagram or table.

Example 1: Determine the Total Number of Outcomes From Two Events

Carrie flips a coin and rolls a standard six-sided die. How many possible outcomes are there?



Solution

Method 1: Create a Table

Coin Flip	Number on Die					
	1	2	3	4	5	6
H (head)	H, 1	H, 2	H, 3	H, 4	H, 5	H, 6
T (tail)	T, 1	T, 2	T, 3	T, 4	T, 5	T, 6

The table shows 12 possible outcomes.

Method 2: Use Multiplication

Number of possible outcomes on die: 6

Number of possible outcomes on coin: 2

Total number of possible outcomes = 6×2
= 12

Multiply the number of possible outcomes for each event.

There are 12 possible outcomes.

Show You Know

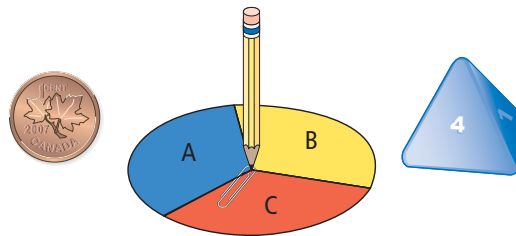
A café offers four types of sandwiches (egg salad, tuna, ham, or turkey) on one of three types of bread (white, rye, or whole wheat).

- Use a table to determine the number of sandwich combinations offered by the café.
- Check your answer using a different strategy.



Example 2: Determine the Total Number of Outcomes From Three or More Events

A coin is flipped, a spinner divided into three equal regions is spun, and a four-sided die numbered 1, 2, 3, and 4 is rolled.



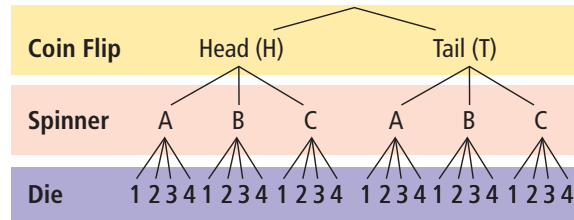
- How many possible outcomes are there?
- Why could you not easily represent the sample space for this probability experiment with a table?

Strategies

Make a Table

Solution

a) Method 1: Use a Tree Diagram



The tree diagram shows 24 possible outcomes.

Method 2: Use Multiplication

Number of possible outcomes for coin flip: 2

Number of possible outcomes for spinner: 3

Number of possible outcomes for die: 4

$$\begin{aligned} \text{Total number of possible outcomes} &= 2 \times 3 \times 4 \\ &= 24 \end{aligned}$$

There are 24 possible outcomes.

- b) A table is ideal for experiments that involve two events, because you can show one event in the columns and one event in the rows. You could not easily represent the sample space for this experiment in a table. For three events, you would need a three-dimensional table or more than one table in order to display all of the outcomes.

Show You Know

A café offers three types of sandwiches (cheese, chicken salad, or tuna) on one of the three types of bread (white, whole wheat, or spelt) with one of two choices of side orders (carrots or chips).

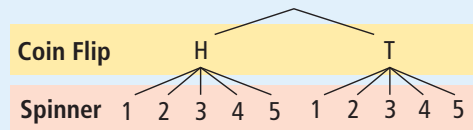
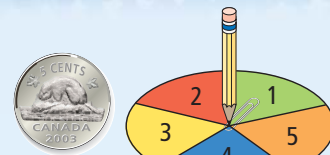
- How many possible combinations are offered by the café?
- Check your answer using a different strategy.

Key Ideas

- The total number of possible outcomes can be determined by counting outcomes shown in a table or tree diagram.

Coin Flip	Number on Spinner				
	1	2	3	4	5
H (head)	H, 1	H, 2	H, 3	H, 4	H, 5
T (tail)	T, 1	T, 2	T, 3	T, 4	T, 5

Total number of possible outcomes from the table: 10



Total number of possible outcomes from the tree diagram: 10

- The total number of possible outcomes can also be determined by multiplying the number of possible outcomes for each event.

Number of possible outcomes from coin flip: 2

Number of possible outcomes from spinner: 5

$$\begin{aligned} \text{Total number of possible outcomes} &= 2 \times 5 \\ &= 10 \end{aligned}$$

Communicate the Ideas

- Jasmine wrote a different number from one to ten on each of ten small pieces of paper and put them in a bag. She drew one number from the bag. At the same time, she flipped a coin. Using three different methods, show another student how to determine the total number of possible outcomes.
- Three flights travel from Lethbridge to Calgary each morning. Four flights go from Calgary to Edmonton in the afternoon. Show two methods for finding how many different ways you could fly from Lethbridge to Edmonton on a given day.
 - Which method is more efficient? Explain your thinking.

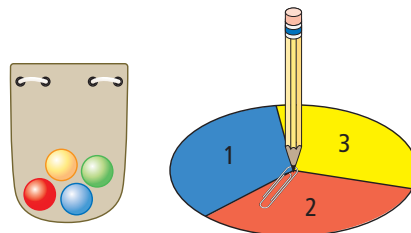


Check Your Understanding

Practise

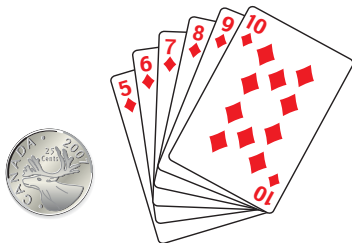
For help with #3 and #4, refer to Example 1 on pages 420–421.

- A bag contains four marbles: one green, one red, one blue, and one yellow. A spinner has three equal sections numbered 1, 2, and 3. A marble is randomly chosen from the bag and the spinner is spun.



- Display the sample space in a table.
- How many possible outcomes does the table show?
- Check your answer to part b) using another strategy.

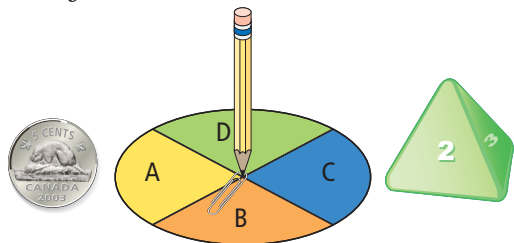
4. Wei flips a coin and randomly draws a card from the set of six cards shown.



- Use a method of your choice to determine the total number of possible outcomes.
- Verify your answer using a different strategy.

For help with #5 and #6, refer to Example 2 on pages 421–422.

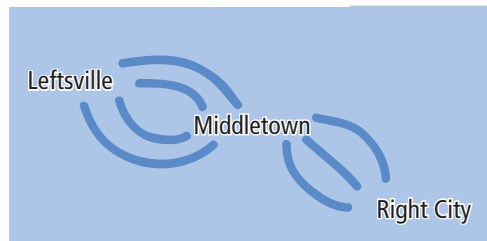
5. A coin is flipped, a six-sided die is rolled, and a marble is randomly selected from a bag containing one black, one yellow, and one red marble.
- Draw a tree diagram to organize the outcomes of these three events.
 - How many possible outcomes are there?
 - Use multiplication to verify the answer to part b).
6. Greta, Joe, and Jared do a probability experiment. Greta flips a coin, Joe spins a spinner divided into four equal regions, and Jared rolls a four-sided die.



- Use a tree diagram to organize the outcomes of these three events.
- How many possible outcomes are there for this probability experiment?
- Verify the answer to part b) by using multiplication.

Apply

- Tony has four different pairs of pants and six different shirts. How many shirt–pant combinations can he make?
- The map shows possible routes between three towns. How many possible routes could you take from Leftsville to Right City?



- The birthday menu at Blue Bird Restaurant gives you one choice from each category:
 Drink: four choices
 Meal: five choices
 Dessert: three choices
 How many different combinations are possible?
- Michaela has a nickel, a dime, and a loonie in her left jacket pocket. She has a penny and a quarter in her right pocket. She randomly picks one coin from each pocket.
 - How many combinations of coins could she get?
 - Use a second method to verify your answer to part a).
 - What is the largest sum possible for these two coins?
 - What is the smallest possible sum?
- Make up a question that would give the following number of possible outcomes:
 $2 \times 4 \times 5 = 40$

Extend

- 12.** An ice-cream store has 31 flavours of ice cream and three types of cones (waffle, sugar, and plain).
- Determine the number of possible single-scoop ice-cream cones.
 - How many two-scoop ice-cream cones are possible if waffle–chocolate–strawberry is considered different from waffle–strawberry–chocolate? Hint: You could have two scoops of the same flavour if you desired.
 - How many two-scoop cones are possible if both flavours of ice cream must be different? Explain your reasoning.
- 13.** A set meal consists of a choice of drink, main dish, and dessert. There are four different desserts, 36 possible meals in total, and more than one choice in each category. Determine the possible number of drink and main dish choices. Explain your reasoning.
- 14.** Alikut is planning to make a beaded yoke for her new parka. She has five colours of beads: red, blue, black, white, and yellow. She wants to use only six shapes of beads: square, circle, star, triangle, rectangle, and heart. Alikut plans to use only one colour of bead in each shape.
- How many colour–shape combinations could she use?
 - Use a second method to verify your answer to part a).
 - Suppose Alikut decides to use two colours of beads in each shape. How many colour–shape combinations could she use now?
- 15.** Determine the number of four-digit numbers that contain only the digits 1, 2, 3, and 4. A digit can be repeated. Two valid numbers are 1423 and 4442.
- 16.** How many car license plates can be made if the first three characters are letters and the last three characters are digits from 2 through 9 inclusive?

MATH LINK

In the stick game, each stick can land in one of two ways—decorated or plain side up.

- Use a different method than you used in section 11.1 to confirm the total number of possible outcomes for a game with four sticks.
- Sometimes the game uses different numbers of sticks. What is the total number of possible outcomes for three sticks? five sticks?
- If there are 128 possible outcomes, how many sticks are being used?