What You'll Learn

CONTENT STANDARDS
7.SP.8, 7.SP.8.b

To make and use sample spaces and to use the counting principle

🔊 **New Vocabulary** sample space, counting principle

✓ **Check Skills You'll Need**

A spinner has eight equal sections numbered 1 to 8. You spin the spinner once. Find each probability.

2. $P(3)$

3. $P(\text{not } 6)$

4. $P(1 \text{ or } 2)$

5. $P(\text{even})$

Why Learn This?

When you are at a salad bar, you can choose from different vegetables, fruits, and dressings. You may want to know all the possible combinations of ingredients you can use.

The collection of all possible outcomes in an experiment is the **sample space.** You can use the sample space to find the probability of an event.

Finding a Sample Space

1 **a.** Make a table to find the sample space for rolling two number cubes colored red and blue. Write the outcomes as ordered pairs.

	1	2	3	4	5	6
1	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(5, 1)	(6, 1)
2	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(5, 2)	(6, 2)
3	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(5, 3)	(6, 3)
4	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(5, 4)	(6, 4)
5	(1, 5)	(2, 5)	(3, 5)	(4, 5)	(5, 5)	(6, 5)
6	(1, 6)	(2, 6)	(3, 6)	(4, 6)	(5, 6)	(6, 6)

← There are 36 possible outcomes.

b. Find the probability of rolling at least one 3.

There are 11 outcomes with at least one 3. There are 36 possible outcomes. So the probability of rolling at least one 3 is $\frac{11}{36}$.

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1 EXAMPLE

a. Make a table to show the sample space for tossing two coins. Write the outcomes as ordered pairs.

	H	T
H	(H, H)	(H, T)
T	(T, H)	(T, T)

← There are 4 possible outcomes.

b. Find $P(T, T)$, the probability of tossing two tails.

There is one outcome for tossing two tails. There are four possible outcomes. So the probability of tossing two tails is $\frac{1}{4}$.

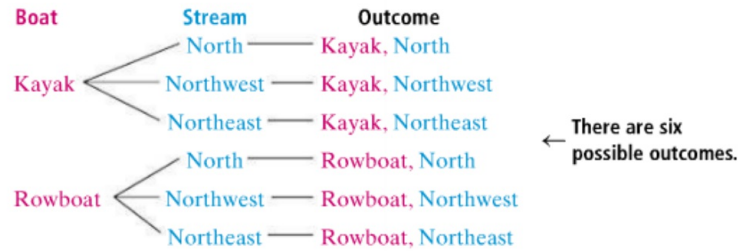You can also show a sample space by using a tree diagram. Each branch of the tree represents one choice.

EXAMPLE   Using a Tree Diagram

2 **River Travel** Suppose you are going to travel on a river. You have two choices of boats—a kayak or a rowboat. You can go upstream on three smaller streams, to the north, northwest, and northeast.

a. What is the sample space for your journey?

Make a tree diagram for the possible outcomes.

Boat	Stream	Outcome
	North	Kayak, North
Kayak	Northwest	Kayak, Northwest
	Northeast	Kayak, Northeast
	North	Rowboat, North
Rowboat	Northwest	Rowboat, Northwest
	Northeast	Rowboat, Northeast

← There are six possible outcomes.

b. Suppose you select a trip at random. What is the probability of selecting a kayak and going directly north?

There is one favorable outcome (kayak, north) out of six possible outcomes. The probability is $\frac{1}{6}$.

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2 EXAMPLE Suppose you can go west or northwest by train, bus, or car.

a. Draw a tree diagram to show the sample space.

Vehicle	Direction	Outcomes
Train	West	Train, West
	Northwest	Train, Northwest
Bus	West	Bus, West
	Northwest	Bus, Northwest
Car	West	Car, West
	Northwest	Car, Northwest

← There are 6 possible outcomes.

b. What is the probability of a random selection that results in a bus trip west?

Vehicle	Direction	Outcomes
Train	West	Train, West
	Northwest	Train, Northwest
Bus	West	Bus, West
	Northwest	Bus, Northwest
Car	West	Car, West
	Northwest	Car, Northwest

There is one favorable outcome (bus, west) out of six possible outcomes.
The probability is $\frac{1}{6}$.

In Example 2 above, there are 2 choices of boats and 3 choices of direction. There are 2×3, or 6, total possible choices. This suggests a simple way to find the number of outcomes—using the **counting principle.**

KEY CONCEPTS **The Counting Principle**

Suppose there are m ways of making one choice and n ways of making a second choice. Then there are $m \times n$ ways to make the first choice followed by the second choice.

Example
If you can choose a shirt in 5 sizes and 7 colors, then you can choose among 5×7, or 35, shirts.

This link will take us to Illuminations activity "Bobbi Bear".

EXAMPLE **Using the Counting Principle**

3 **Gridded Response** How many different sandwiches can you order when you choose one bread and one meat from the menu?

Use the counting principle.

Bread		**Meat**		
number of choices	$\times$	number of choices		
5	$\times$	6	$=$	30

There are 30 different sandwiches available.

THE
DELI COUNTER
SANDWICHES

FRESH BREADS	DELI MEATS
Rye	Roast Beef
Wheat	Turkey
White	Ham
Pita	Pastrami
Wrap	Salami
	Liverwurst

How many kinds of coin purses are available if the purses come in small or large sizes and colors red, blue, yellow, and black?

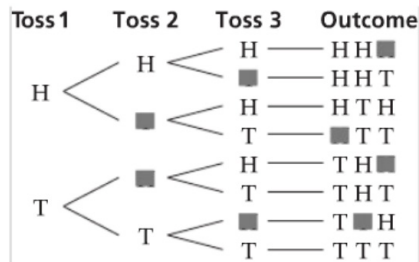| Sizes	Colors
small	red
large	blue
	yellow
	black

Use the counting principle.

Size		**Color**	
number of choices	×	number of choices	
2	×	4	= 8

There are 8 different kinds of coin purses available.

✓ Check Your Understanding

1. Vocabulary What is a sample space?

2. Complete the tree diagram for tossing a coin three times.

Use your completed diagram from Exercise 2 to find each probability.

3. $P(\text{HHH}) = \dfrac{\blacksquare}{8}$

4. $P(\text{TTT}) = \dfrac{1}{\blacksquare}$

5. $P(\text{at least one H}) = \dfrac{\blacksquare}{8}$

6. $P(\text{exactly 2 T's}) = \dfrac{\blacksquare}{8}$

7. If you toss 4 coins, how many possible outcomes are there?

9-3 • Guided Problem Solving

GPS **Student Page 323, Exercise 23:**

   a. Clothes Ardell has four suit jackets (white, blue, green, and tan) and four dress shirts in the same colors. How many different jacket/shirt outfits does Ardell have?

   b. Suppose he grabs a suit jacket and a dress shirt without looking. What is the probability that they will *not* be the same color?

Understand

   1. Circle the information you will need to solve.

   2. How do you find probability?

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Plan and Carry Out

   3. How many different suit jackets are there?   ——————

   4. How many different dress shirts are there?   ——————

   5. Using the counting principle, how many different jacket/shirt outfits does Ardell have?   ——————

   6. How many same color jacket/shirt outfits does Ardell have?   ——————

   7. How many different color jacket/shirt outfits does Ardell have?   ——————

   8. What is the probability that they will *not* be the same color?   ——————

Check

   9. How else could you find the total number of jacket/shirt outfits?

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Solve Another Problem

   10. a. Joseph has three pairs of shoes (white, brown, and black) and four pairs of socks (white, brown, black, and blue). How many sock/shoe pairs are there? ——————

     b. If Joseph selects a pair of shoes and a pair of socks without looking, what is the probability they will be the same color?

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