

# 9 Exploring Multiplication

***Dear Student,***

To multiply larger numbers, such as  $27 \times 58$ , it helps to know some multiplication facts well. Some facts that might help you solve this problem are shown below.

Do you already know these facts?

In this chapter, you will improve your knowledge of multiplication facts, and begin to see how these facts can help you multiply larger numbers. The games and puzzles will also give you many chances to show what you already know.

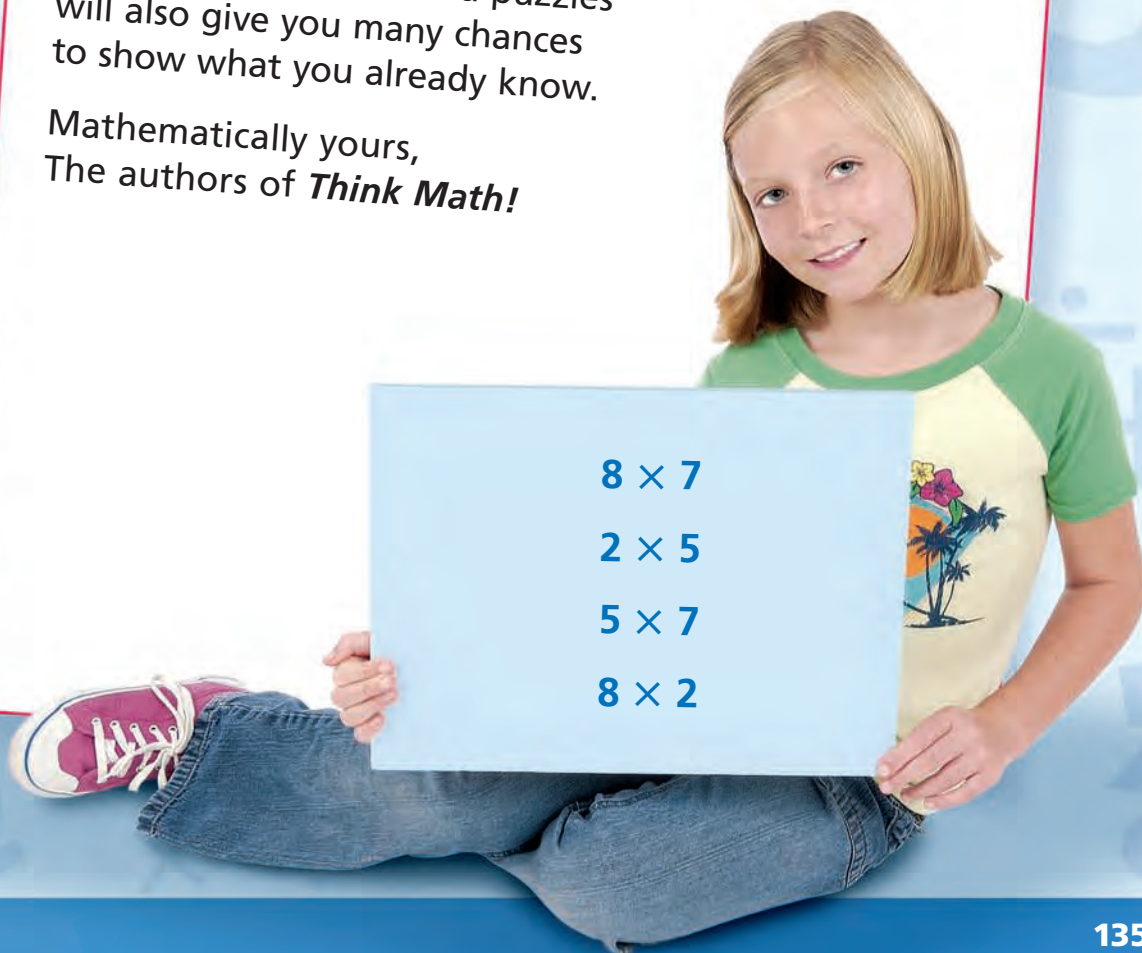
Mathematically yours,  
The authors of ***Think Math!***

$$8 \times 7$$

$$2 \times 5$$

$$5 \times 7$$

$$8 \times 2$$



# Collections

**A**re you a collector? Some people collect model cars, dolls, or stamps. Others collect more unusual items such as potato chip bags or gum wrappers. Lauren collects key chains. The table below shows the types of key chains Lauren collects.

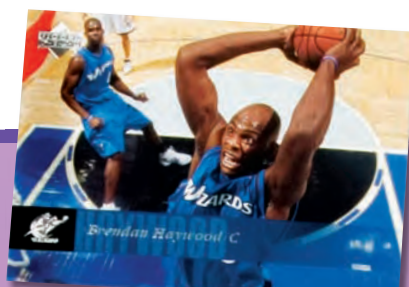


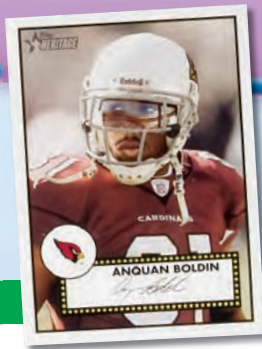
## FACT • ACTIVITY 1

Use the table to answer the questions.

- 1 How many types of key chains are in each group? Animals? Fashion? Sports? Vehicles?
- 2 Lauren has 5 of each type of fashion key chain. How many fashion key chains does she have?
- 3 Lauren has 9 of each type of animal key chain. How many animal key chains does she have in her collection?
- 4 Find the total number of sports key chains Lauren has if she has 8 of each.
- 5 Lauren has 2 of each type of vehicle key chain. Does she have more vehicle or more fashion key chains?
- 6 Lauren also collects key chains of attractions from U.S. states. She has 5 key chains each from 14 different states. Draw an array to help you find  $5 \times 14$ . Break the array into two smaller arrays. What is the total number of state key chains?

Lauren's Key Chain Collection	
Key Chains	Types
Animals	cats, birds, fish, dogs
Fashion	shoes, hats, jewelry
Sports	baseball, football, soccer, basketball, tennis, car racing, golf
Vehicles	cars, boats, bikes, motorcycles, planes, trains





baseball



basketball



football



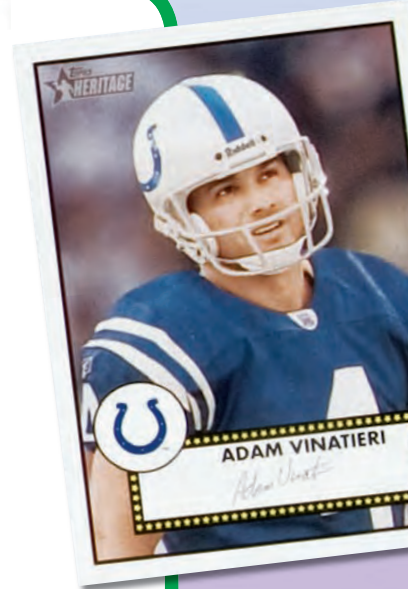
soccer

**S**ports card collecting started in the 19th century. It became more popular around 1933 when baseball stars such as Babe Ruth and Ty Cobb were featured.

## FACT-ACTIVITY 2

**Matt has a collection of 120 sports cards that includes baseball, football, basketball, and soccer cards. Use Matt's collection for 1–3.**

- 1** Matt arranged his cards in an array with 12 rows. How many columns are in his array?
- 2** In Matt's display, there are 4 rectangular sections, one for each sport. Break his array into 4 different sections to show one possibility for Matt's display.
- 3** Using Matt's array, how many cards of each sport are in each section? Write a multiplication sentence for each section.



## CHAPTER PROJECT

Choose an item you would like to collect. Gather, draw, or find pictures of at least 36 of the items.

Separate the collection into at least 3 different groups, either by color, size, or some other attribute. Arrange some or all of the items or pictures in each group in an array. Lay the groups out on a table.

Draw your array on a poster. Show how multiplication can be used to find the number of items in each group and the total number of items displayed in the collection.



## ALMANAC Fact

A key chain is not just a simple metal key ring attached to your keys. You can find all kinds of fancy key chains from cartoon characters to flash lights and even the world's smallest calendar.

## EXPLORE

## Exploring Products

How many ways can you make the products?

Find at least two ways to write each number below as the product of two numbers (not including 1). Use tiles or counters to help you.

**Example:**  $20 = 5 \times 4$  and  $20 = 2 \times 10$

1 24

2 30

3 45

4 56

5 36

6 32

7 48

8 16

9 28

10 18

11 42

12 54

You may use grid paper or drawings of intersecting lines to help you find the product.

13  $5 \times 12$

14  $9 \times 8$

15  $11 \times 11$

16  $7 \times 11$

17  $11 \times 12$

18  $6 \times 12$

19  $11 \times 10$

20  $9 \times 7$

21  $12 \times 12$

# REVIEW MODEL

## Using Models to Multiply

You can use models to help you multiply.

**You can use counters.**

**Example**  $3 \times 8 = \blacksquare$

You can make an array with 3 rows and 8 counters in each row. Then find the total number of counters in your array.

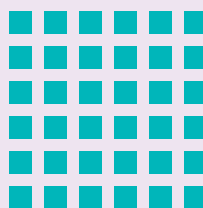


There are  
24 counters.  
So,  $3 \times 8 = 24$ .

**You can use square tiles.**

**Example**  $6 \times 6 = \blacksquare$

You can make an array with 6 rows and 6 tiles in each row. Then find the number of tiles in your array.

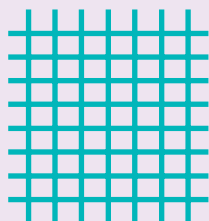


There are 36 tiles.  
So,  $6 \times 6 = 36$ .

**You can draw intersecting lines.**

**Example**  $8 \times 7 = \blacksquare$

You can draw 8 horizontal lines and 7 vertical lines. Then find the number of intersections.

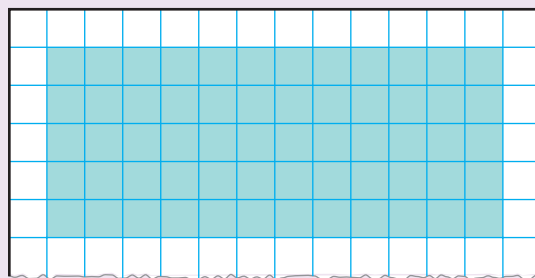


There are 56 intersections.  
So,  $8 \times 7 = 56$ .

**You can use grid paper.**

**Example**  $5 \times 12 = \blacksquare$

You can shade an array with 5 rows and 12 columns. Then find the number of squares in your array.



There are 60 squares.  
So,  $5 \times 12 = 60$ .

### ✓ Check for Understanding

Find the product. You may use any model you wish.

1  $4 \times 7 = \blacksquare$

2  $12 \times 6 = \blacksquare$

3  $9 \times 8 = \blacksquare$

4  $5 \times 9 = \blacksquare$

**Missing Factors**

**Use tiles or counters to solve the problem. Draw a picture to represent your solution, and write a number sentence to describe it.**

- 1** Mrs. Kay gave the same number of stickers to each of her 4 grandchildren. She gave away 36 stickers. How many stickers did each child get?  
  

---
- 2** After school, a team of 9 students cleaned up the playground. Each student picked up 4 bags of trash. How many bags did the team collect?  
  

---
- 3** The Pet Store sells dog treats in packages of 6 treats. The store sold 48 dog treats yesterday. How many packages did they sell?  
  

---
- 4** Cindy is playing a card game to test her memory. She neatly lines up 48 cards in 8 rows and places them face down. How many cards are in each row?

## REVIEW MODEL

## Fact Families

You can write multiplication and division fact families for problem situations.

**Example**

Angela displays her collection of quarters in an array.



You can use multiplication and division to describe the array.

**Use multiplication to tell how many quarters in the array.**

Multiply the number of rows by the number of columns, or

$$4 \times 6 = 24 \text{ quarters}$$

multiply the number of columns by the number of rows.

$$6 \times 4 = 24 \text{ quarters}$$

**Use division to tell how many quarters are in each row or column.**

Divide the total by the number of rows.

$$24 \div 4 = 6 \text{ columns}$$

Divide the total by the number of columns.

$$24 \div 6 = 4 \text{ rows}$$

The same numbers are used in all the facts. These related multiplication and division number sentences are called a **fact family**.

## ✓ Check for Understanding

Write a fact family for each situation.



- 2 Suki picked 32 tomatoes. She gave the same number of tomatoes to each of her 4 neighbors.

## Using 10 as a Factor

What pattern can help you multiply by 10?

1

You already know these products.

$$\begin{array}{cc} 3 \times 10 & 10 \times 8 \\ & 4 \times 10 \\ 10 \times 7 & 10 \times 1 \end{array}$$

Now try to find these products. Then use a calculator to check your answers.

$10 \times 12$

$10 \times 10$

$16 \times 10$

$10 \times 23$

$45 \times 10$

$87 \times 10$

2

Think about the related number sentences for this sentence . . .

$$10 \times 36 = 360$$

. . . to help you complete the number sentence and write the related number sentences.

$680 = \blacksquare \times 68$

$\blacksquare = \blacksquare \times \blacksquare$

$\blacksquare = \blacksquare \div \blacksquare$

$10 = \blacksquare \div 68$

3 What number must you multiply by 10 to get 370? Write the four related number sentences.

4 Find two numbers with a product of 530, and write a number sentence that uses those numbers.

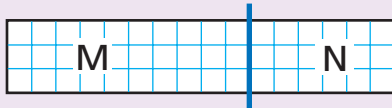
See if you can find another pair of numbers with a product of 530, and write a multiplication sentence that uses those numbers.

## REVIEW MODEL

## Making Simpler Problems

You can use smaller arrays to help you find the number of squares in a larger array.

**Example A** You can draw a line to separate a large array into two smaller arrays.



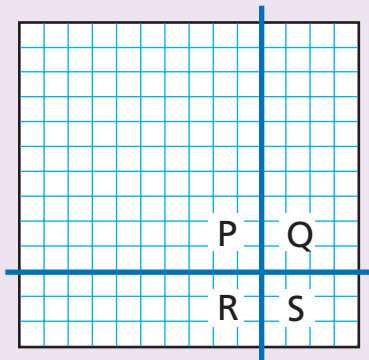
Write a multiplication sentence to find the number of squares in each small array.

$$M: 3 \times 10 = 30 \quad N: 3 \times 6 = 18$$

Add the number of squares in each small array to find the number of squares in the large array.

$$30 + 18 = 48 \quad \text{So, } 3 \times 16 = 48$$

**Example B** You can draw two lines to separate a large array into four smaller arrays.



Write a multiplication sentence to find the number of squares in each small array.

$$P: 10 \times 10 = 100 \quad Q: 10 \times 4 = 40 \\ R: 3 \times 10 = 30 \quad S: 3 \times 4 = 12$$

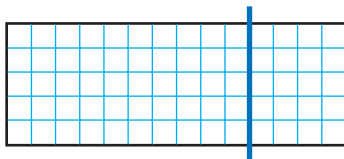
Add the number of squares in each small array to find the number of squares in the large array.

$$100 + 40 + 30 + 12 = 182 \\ \text{So, } 13 \times 14 = 182$$

### ✓ Check for Understanding

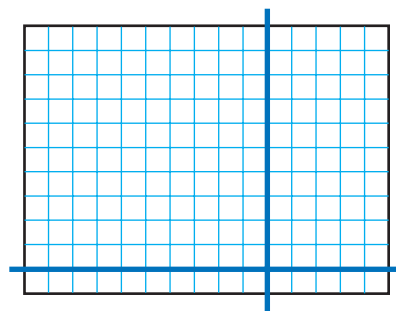
Find the number of squares in the larger array.

1



$$5 \times 14 = \blacksquare$$

2

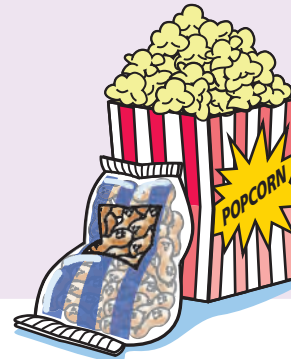


$$11 \times 15 = \blacksquare$$

## REVIEW MODEL

**Problem Solving Strategy**  
**Guess and Check**

At the baseball game, Toby spent \$6.00 on snacks. He bought a large bag of popcorn and a small bag of peanuts. The bag of popcorn cost 3 times as much as the bag of peanuts. What was the cost of the peanuts? What was the cost of the popcorn?

**Strategy:** Guess and Check**Read to Understand**

What do you know from reading the problem?

Toby spent \$6.00 on a bag of popcorn and a bag of peanuts.  
The popcorn cost 3 times as much as the peanuts.

**Plan**

How can you solve this problem?

You can use the strategy *guess and check*.

**Solve**

How can you use this strategy?

Guess the cost of the peanuts, and use this guess to find the cost of the popcorn. Start with an amount less than \$6.00, such as \$1.00. If peanuts are \$1.00, then popcorn is 3 times more, or \$3.00:  $\$1.00 + \$3.00 = \$4.00$ .

That guess is too low, so adjust the guess. If peanuts are \$1.50, then popcorn is \$4.50.  $\$1.50 + \$4.50 = \$6.00$ . So, that guess is correct.

**Check**

Look back at the problem. Did you answer the questions that were asked? Do the answers make sense?

## Problem Solving Practice

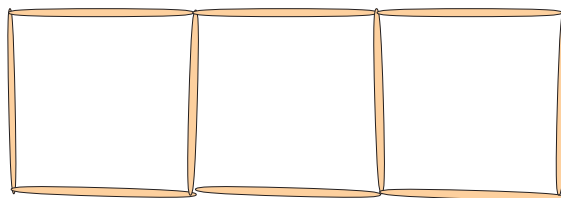
Use the strategy *guess and check*.

- 1 The sum of two numbers is 10. Their product is 24. What are the two numbers?
- 2 There were 125 campers at the cookout. Each camper ordered either a hot dog or a hamburger. There were 25 more hot dog orders than hamburger orders. How many hot dogs were ordered? How many hamburgers were ordered?

## Mixed Strategy Practice

Use any strategy to solve. Explain.

- 3 Suppose you start an exercise program by exercising 15 minutes a day. If every week you increase your daily exercise time by 5 minutes, during which week would you be exercising 30 minutes a day?
- 4 At the birthday party,  $\frac{5}{6}$  of the chocolate cake got eaten and  $\frac{5}{8}$  of the vanilla cake got eaten. If the cakes were the same size, which cake had the greater amount eaten?
- 5 Six children went apple picking. Each child picked 17 apples. How many apples did they pick?
- 6 Vincent is watching his favorite movie. The movie is 138 minutes long. If he stops the movie after 2 hours, how many minutes will Vincent have left to watch?
- 7 Nona is using toothpicks to make the design shown at right. How many toothpicks will Nona need to make 14 squares in a row?



### Problem Solving Strategies

- ✓ Act It Out
- ✓ Draw a Picture
- ✓ **Guess and Check**
- ✓ Look for a Pattern
- ✓ Make a Graph
- ✓ Make a Model
- ✓ Make an Organized List
- ✓ Make a Table
- ✓ Solve a Simpler Problem
- ✓ Use Logical Reasoning
- ✓ Work Backward
- ✓ Write a Number Sentence

Choose the best vocabulary term from Word List A for each sentence.

- 1 Multiplication is   ?   because switching the factors does not change the answer.
- 2 A set of multiplication and division sentences that use the same three numbers is called a(n)   ?  .
- 3 The   ?   is the answer in a multiplication problem.
- 4 A(n)   ?   is an arrangement of objects in rows and columns.
- 5 You can   ?   rows in two arrays to make a larger array (if the number of columns is the same).

Complete each analogy using the best term from Word List B.

- 6 Add is to multiply as addend is to   ?  .
- 7 Addend is to sum as factor is to   ?  .

## Word List A

array  
combine  
commutative  
Cross Number  
Puzzle  
fact family  
factor  
product  
separate

## Word List B

fact family  
factor  
product  
array

## Talk Math

Discuss with a partner what you have learned about multiplication. Use the vocabulary terms **factor**, **product**, **separate**, and **combine**.

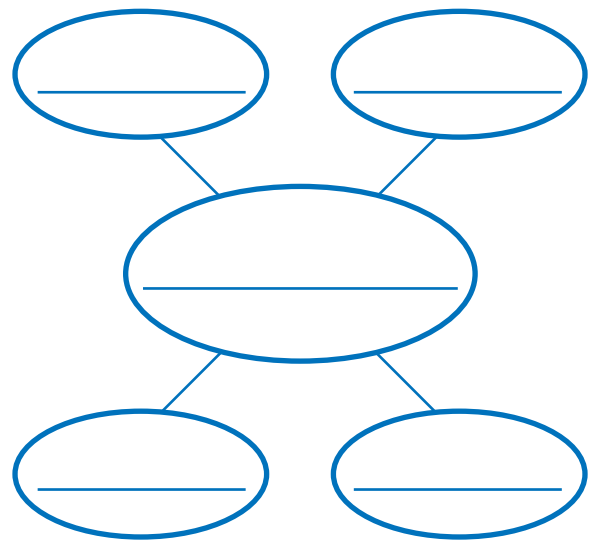
- 8 How can you write a multiplication and division fact family from an array?
- 9 How can you use an array to multiply two numbers?
- 10 How is a Cross Number Puzzle like an array?

## Analysis Chart

- 11 Create an analysis chart for the terms *combine*, *commutative*, *fact family*, *factor*, and *product*.


## Concept Map

- 12 Create a concept map using the term *fact family*. Use what you know and what you have learned about addition, subtraction, multiplication, and division.



**FACTOR** The word *factor* is often used in everyday life. A *factor* is something that is important for something to happen. It could also be a part of a process. Good study habits are a *factor* in school success. Price could be a *factor* when choosing a new jacket.

In math, the word *factor* also has to do with making something happen. We say 3 and 4 are *factors* of 12 because  $3 \times 4$  results in 12.



### Technology

Multimedia Math Glossary

[www.harcourtschool.com/thinkmath](http://www.harcourtschool.com/thinkmath)

# GAME

## Tic-Tac-Toe Multiplication

### Game Purpose

To select factors and find products

### Materials

- Activity Masters 95 to 98:  
Tic-Tac-Toe Multiplication
- Two-color counters



### How to Play the Game

- 1 This is a game for 2 players. You each will need about 20 counters. Decide who will use each color.
- 2 Place your gameboard (Activity Master 95, 96, 97, or 98) between you. One player faces the numbers in the *Player A* box. The other player faces the numbers in the *Player B* box.
  - Player A chooses a number from his or her box. Player A says the number aloud and places a counter on it.
  - Player B chooses an unused factor from his or her box that can be multiplied with Player A's factor to make a product on the gameboard. Player B places a counter on the factor and on the product.
  - If Player B cannot make a product, he or she loses a turn. Then Player B must name the next factor for Player A.
- 3 Take turns choosing factors and placing counters on products on the gameboard.
- 4 The first player to cover 3 products in a line—across, down, or diagonally—wins.

# GAME

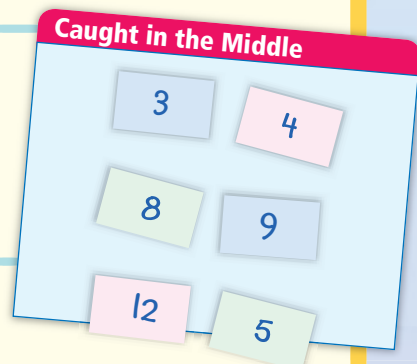
## Caught in the Middle

### Game Purpose

To practice identifying factors and products

### Materials

- Index cards

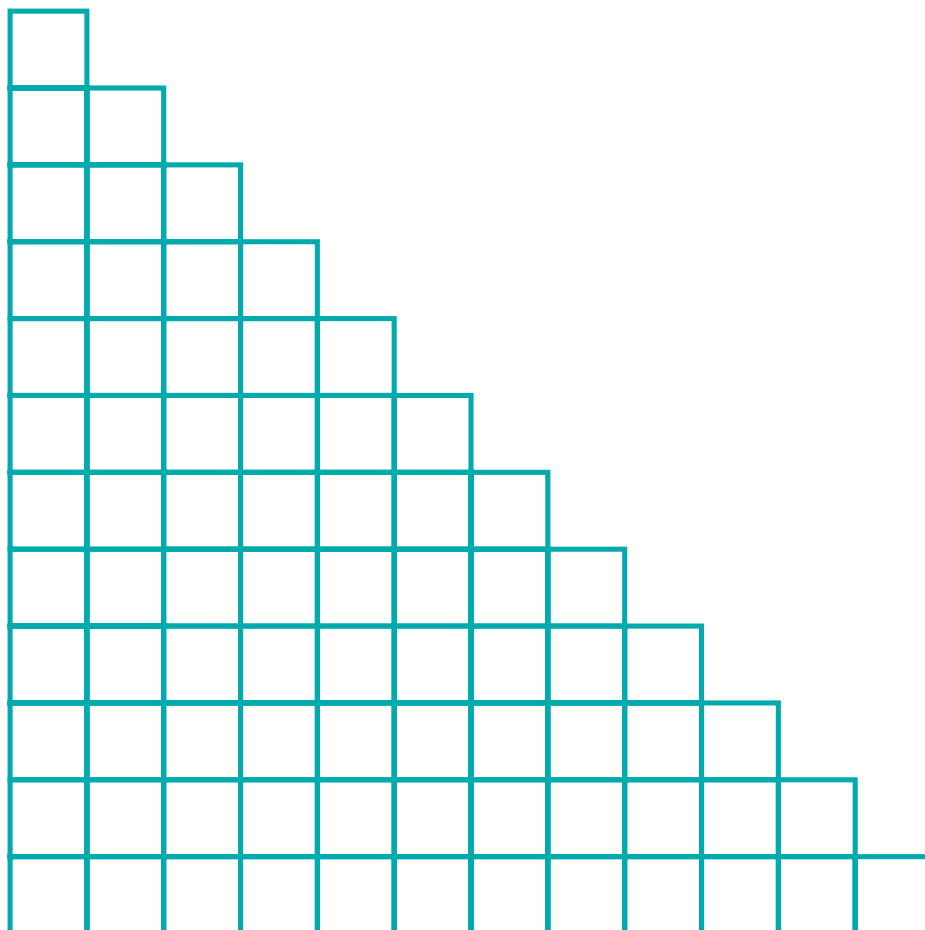


### How to Play the Game

- 1** This is a game for 3 players. Make 4 sets of index cards numbered 1 through 12.
- 2** Mix up the cards. Place them face down in a pile.
  - Each player takes two cards and turns them face up. Take turns saying aloud the product of your numbers. Be sure to notice who has the product with the value between the other two products—the middle value, not the highest or lowest.
  - Take turns naming a different pair of numbers (not including 1) that also make your product. For example, a player who gets 4 and 8 could name 2 and 16, even though 16 is not a card.
  - If you can make your product a different way, place any one of your own cards face down in your “won pile.” If you have the product in the middle, take the rest of the face-up cards for your “won pile.” If there is no middle value because two players have the same product, the player with the different product can take the remaining cards.
- 3** Play until there are not enough cards for each player to take 2 cards. The player with the most cards in his or her “won pile” wins.

# CHALLENGE

Make a copy of this grid. Then draw arrays for as many of the multiplication facts below as you can. Do not overlap arrays. Make each array a different color. Try to fill as much of the grid as you can. Can you fill the entire grid?



## MULTIPLICATION FACTS

$1 \times 12$

$2 \times 10$

$3 \times 9$

$4 \times 8$

$5 \times 7$

$6 \times 6$

$1 \times 5$

$1 \times 6$

$2 \times 5$

$3 \times 5$

$5 \times 5$

$4 \times 6$

$1 \times 2$

$1 \times 3$

$2 \times 3$

$3 \times 3$

$4 \times 3$

$6 \times 3$