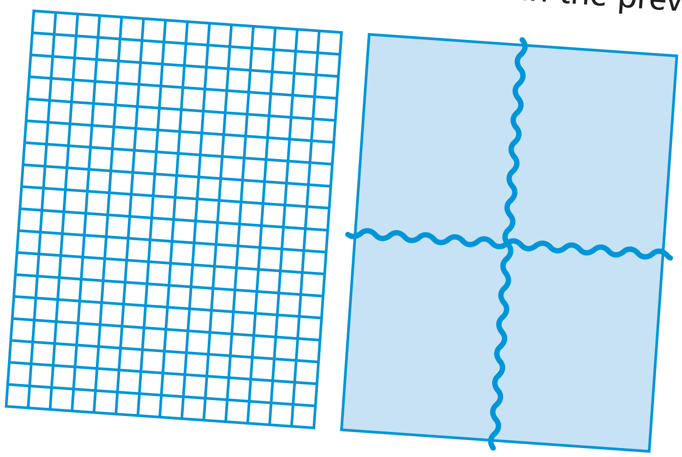
Chapter

6 Multi-Digit Multiplication

Dear Student,

This chapter is about multiplying big numbers. Can you think of situations when you've used multiplication in class or outside of school?

As you work through the multiplication problems in this chapter, you will be seeing pictures like these, which may remind you of the ones you saw in the previous chapter.



How might these pictures be related to multiplication?

Of course you already know a lot about multiplication. You will have a chance to use what you know to complete multiplication puzzles. Enjoy!

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

THE WORLD ALMANAC FOR KIDS

Watt's Up?

We depend on electricity for many things, for example to power appliances. Electricity is usually generated by burning fossil fuels, such as coal and oil. When fossil fuels are used up, they cannot be replaced. We can conserve those fossil fuels by using less electricity. The standard unit of measurement for electrical power is the watt. The table shows the amount of power needed to operate some electric devices for one hour.

FACT·ACTIVITY 1

How much electricity is used?

Energy used per hour	Device	Energy used per hour	Device
5000 watts	Electric oven (800 for a range burner)	20 watts	Desktop computer & monitor (in sleep mode)
3500 watts	Central air conditioner	75 watts	Regular light bulb
1500 watts	Toaster (four-slot)	165 watts	Video game box
1000 watts	Window unit air conditioner	90 watts	19" television
700 watts	Refrigerator	18 watts	Compact fluorescent light bulb
240 watts	Desktop computer & monitor (running)	4 watts	Clock radio

1. Estimate the energy used by a 19" television in 12 hours.
2. Dorian plays a video game box for 3 hours. Estimate the energy used.
3. Which uses more energy in one hour, 12 regular light bulbs or 50 compact fluorescent light bulbs?
4. Justine claims that a computer in running mode uses 12 times more energy than a computer in sleep mode. Is she correct? Explain.

One power plant can produce enough electricity for 540,000 people. That amount of energy would be enough for 180,000 homes with an average of 3 people per home. For which of these Texas cities could one power plant produce enough electricity?

Population of Some Texas Cities	
City	**Population**
Arlington	362,805
Austin	690,252
Corpus Christi	283,474
El Paso	598,590
Fort Worth	624,047
Temple	55,447

FACT • ACTIVITY 2

Use the population data to answer.

1. Round each population so that it can be written as a multiple of 100.
2. Write the rounded population of Temple as the product of 100 and a whole number.
3. Write the rounded population of Corpus Christi as the product of 100 and a whole number.
4. The population of Austin is about 690,000. Write the rounded population of Austin as the product of 100 and two whole numbers. $\blacksquare \times \blacksquare \times 100 = \blacksquare$

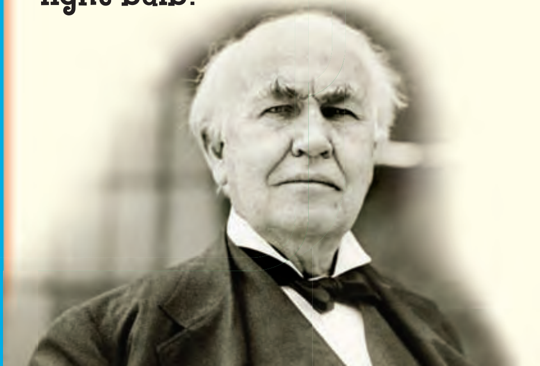
CHAPTER PROJECT

How much energy could we save? Choose a total of 5 electric devices that you or your family use regularly. Create a table which would show how many watts of power could be saved in a year if the device is used for 1 less hour a day, every day. You may use a calculator to help with the calculations.

For example: Using the television for 1 less hour a day would save 90 watts of electricity every day. This means that you could save 90×365 (days in a year) $= 32{,}850$ watts per year. Add this savings to the others to find total savings. Present your results in a pamphlet that will promote energy savings. Write a slogan for your pamphlet.

ALMANAC Fact

Thomas A. Edison was one of the first to harness electricity for inventions that changed people's lives, including the phonograph and the light bulb!



Chapter 6
Lesson 2

EXPLORE
Multiples of 10 and 100

1. Which of the numbers below can be made by **multiplying** a whole number by **10**?

16 **250** **77** **25** **30** **100** **10** **5** **55** **1,300** **90**

Use **base-ten blocks** to show that these numbers are **multiples of 10**.

2. Which of the numbers below can be made by **multiplying** a whole number by **100**?

160 **250** **77** **25** **300** **100** **10** **50** **550** **1,300** **900**

Use **base-ten blocks** to show that these numbers are **multiples of 100**.

Chapter 6

Lesson 3

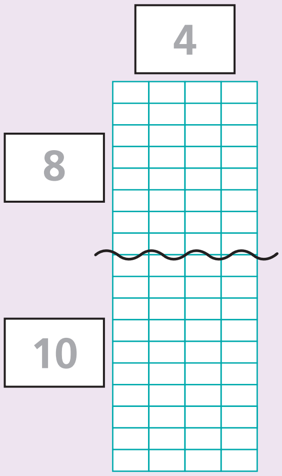
REVIEW MODEL
Using Arrays to Model Multiplication

You can use an array and a chart to model multiplication. You can break a number into the sum of two smaller numbers to use simpler multiplication and find a product.

Step 1 **Fill in the boxes with the number of rows and columns that make up the two parts of the array.**

18 × 4 = ■

This is an 18 × 4 array that is divided into an 8 × 4 array and a 10 × 4 array.



Step 2 **Fill in the chart by adding the numbers above the thick line.**

This chart shows that you are splitting 18 into 8 + 10.

×	4
8	
10	
18	

Step 3 **Fill in each cell above the thick line by multiplying the numbers in its rows and columns.**

This shows that you can solve simpler problems to find products of larger numbers.

×	4
8	32
10	40
18	

Step 4 **Fill in the remaining cells of the chart by adding the two numbers above it.**

(8 × 4) + (10 × 4) = 72, so 18 × 4 = 72

×	4
8	32
10	40
18	72

Check for Understanding

Copy the chart and fill in the missing parts.

1. 17 × 5 =

×	5
8	■
9	■
■	■

2. 19 × 3 =

×	3
11	■
8	■
■	■

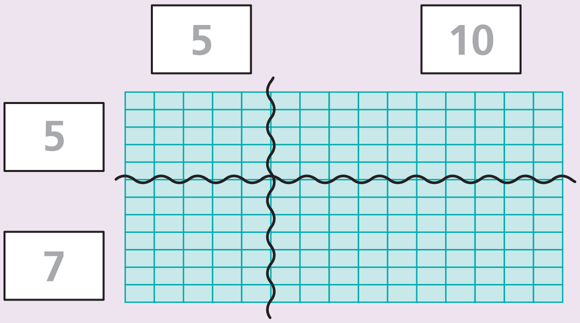
REVIEW MODEL
Splitting Larger Arrays

You can break an array into four parts and use simpler problems to solve a multi-digit multiplication problem.

Step 1 Fill in the boxes with the number of rows and columns that make up the four parts of the array.

$15 \times 12 = ?$

The array is divided into 4 smaller arrays: $(5 \times 5) + (5 \times 10) + (7 \times 5) + (7 \times 10)$.



Step 2 Fill in the top row and left column. Here, 15 is the sum of 5 and 10, and 12 is the sum of 5 and 7.

×	5	10	15
5			
7			
12			

Step 3 Fill in each number shown in blue by multiplying the shaded numbers in its row and column. Fill in each number shown in gray by adding the blue numbers in its row or column.

×	5	10	15
5	25	50	75
7	35	70	105
12	60	120	180

Notice that there are two sets of numbers that add to 180.

$15 \times 12 = 180$

Check for Understanding

Copy the chart and fill in the missing parts.

1. $14 \times 13 =$

×	4	10	■
8	■	■	■
5	■	■	■
■	■	■	■

2. $18 \times 16 =$

×	9	9	■
10	■	■	■
6	■	■	■
■	■	■	■

EXPLORE
Multiplication Records

$$25 \times 33 = ?$$

1 Find the product using any method you choose. You can use the **Multiplication Tools page 438** if you want to use an area model or chart to solve the problem.

2 Here is the beginning of one student's work:

$$\begin{array}{r} 25 \\ \times\ 33 \\ \hline 600 \\ 150 \\ 60 \\ 15 \end{array}$$

Can you find the numbers **600**, **150**, **60**, and **15** in your solution? Where did 600, 150, 60, and 15 come from?

Chapter 6

Lesson 7

REVIEW MODEL
Recording Your Process of Multiplication

You can record your steps in multiplying multi-digit numbers in a vertical format. 45 × 36 =

Step 1

Divide each factor into the sum of two numbers: the largest possible multiple of 10 and a one-digit number.

$45 = \boxed{40} + \boxed{5}$

$36 = \boxed{30} + \boxed{6}$

Step 2

Fill in the partial products.

$$\begin{array}{rr} & 45 \\ & \times\ 36 \\ \hline 6 \times 40 \rightarrow & \boxed{240} \\ 6 \times 5 \rightarrow & \boxed{30} \\ 30 \times 40 \rightarrow & \boxed{1{,}200} \\ 30 \times 5 \rightarrow & \boxed{150} \end{array}$$

Step 3

Add the partial products.

$$\begin{array}{rr} & 45 \\ & \times\ 36 \\ \hline 40 \times 6 \rightarrow & \boxed{240} \\ 5 \times 6 \rightarrow & \boxed{30} \\ 30 \times 40 \rightarrow & \boxed{1{,}200} \\ 30 \times 5 \rightarrow & \boxed{150} \\ \hline & \boxed{1{,}620} \end{array}$$

Check for Understanding

Calculate each product.

1. 26 × 17 =

$$\begin{array}{r} 26 \\ \times\ 17 \\ \hline \boxed{■} \\ \boxed{■} \\ \boxed{■} \\ \boxed{■} \\ \hline \boxed{■} \end{array}$$

2. 32 × 48 =

$$\begin{array}{r} 32 \\ \times\ 48 \\ \hline \boxed{■} \\ \boxed{■} \\ \boxed{■} \\ \boxed{■} \\ \hline \boxed{■} \end{array}$$

Chapter 6
Lesson 9

EXPLORE
Using Multiplication

Read each problem and decide whether you would use multiplication to answer the question. If you would not use multiplication, what operation would you use? Then solve the problems.

1. Nina has **6 pairs of pants** and **8 different shirts**. How many different outfits can she make with her clothes?

outfits

2. Eric is putting all **36 of his shirts** into **4 drawers.** He puts the same number of shirts in each drawer. How many shirts will he put in each drawer?

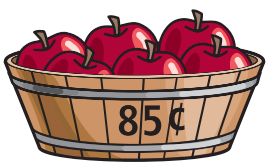
shirts

3. The doctor told Paul that he is **5 feet and 6 inches** tall. Paul wanted to sound taller, so he figured out his height in inches. How many inches tall is Paul?

12 inches = 1 foot

inches

4. There are **659 students** in a school. The principal orders **1 apple** for each student. Apples are sold in baskets of **6 for 85¢**. How much will this order cost?



Chapter 6

Lesson 10

REVIEW MODEL

Problem Solving Strategy

Guess and Check

The sum of two numbers is 22 and their product is 121. What are the two numbers?

Strategy: Guess and Check

Read to Understand

What do you know from reading the problem?

The sum of the two numbers is 22 and their product is 121

What do you need to find out?

What are the two numbers?

Plan

How can you solve this problem?

Think about the strategies you might use. You can guess and check.

Solve

How can you use the strategy guess and check to help solve this problem?

Guess two numbers that have a sum of 22 and check to see if their product is 121.

Check

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

Problem Solving Practice

Use the strategy *guess and check* to solve.

1. Find the missing digits in the following multiplication problem.

$$\begin{array}{r} 1\,\blacksquare\,4 \\ \times \quad \blacksquare \\ \hline \blacksquare\,6\,8 \end{array}$$

2. Jayme saved $215 during the months of January and February. She saved $35 more in January than she did in February. How much money did she save in each of the two months?

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 an Equation

Mixed Strategy Practice

Use any strategy to solve. Explain.

3. When Yen wrote the number 3 on the board, she said the number 9. When she wrote 6, she said 36. When she wrote 10, she said 100. If Yen wrote 7, what would she say?

4. Casey wants to buy a new outfit for a school banquet. She has a choice of three blouses, four skirts, two pair of pants, and one pair of shoes. How many different outfits can Casey make?

5. Kellie paid $3 each for 15 picture frames and sold them for $9 each. What was Kellie's profit?

6. How many different three digit numbers can be made using some or all of the digits 2, 4, and 6?

7. Carlo had basketball practice after school for 1 hour 45 minutes. He then walked to Alex's house in 20 minutes. He played video games for 35 minutes before walking 5 minutes home. He arrived home at 6:15. What time did basketball practice start?

8. Kim needs to put a fence around her rectangular garden to keep her dog away from her plants. The garden is 15 feet long and 8 feet wide. What is the area of her garden?

Chapter 6 Vocabulary

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

1. The number 70 is a(n) __?__ of 10.
2. The length of a rectangle is one __?__ of the rectangle.
3. You can use a __?__ to multiply instead of using an array, grid, or table.
4. A(n) __?__ divides a space evenly into same-size squares.
5. An arrangement of objects in rows and columns is called a(n) __?__.
6. To __?__ is to find a number that is close to an exact amount.
7. A(n) __?__ is used to display and organize information.
8. Miles, minutes, quarts, and kilograms are examples of __?__.
9. The __?__ states that multiplying a sum by a number is the same as multiplying each addend by the number and then adding the products.

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

10. Letter is to word as __?__ is to sum.
11. Accurate calculation is to "exact amount" as __?__ is to "about how many".

Word List A

- array
- Commutative Property
- dimension
- Distributive Property
- estimate
- grid
- multiple
- partial product
- reasonableness
- table
- units
- vertical format

Word List B

- estimate
- partial product
- unit

Talk Math

Discuss with a partner what you have just learned about multiplying. Use the vocabulary terms *partial product*, *multi-digit number*, and *grid*.

12. How does splitting numbers make it easier to multiply multi-digit numbers?
13. How is using a vertical format to multiply like using a grid?

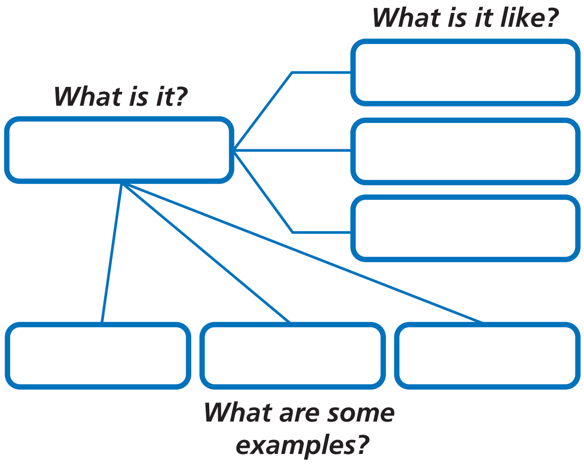
Word Definition Map

14 **Create a word definition map for the word *estimation.***

A What is it?

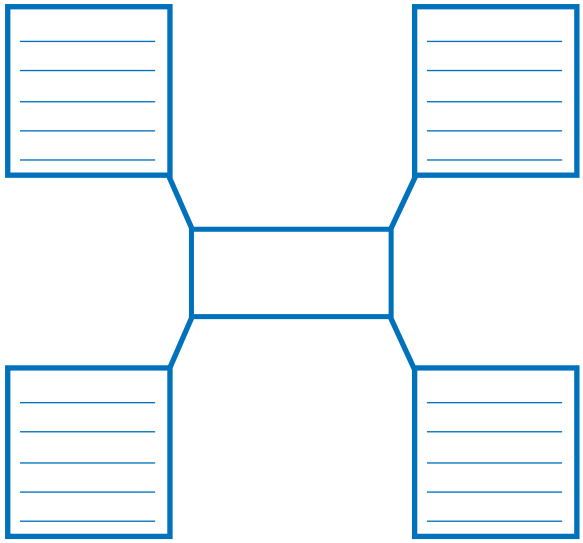
B What is it like?

C What are some examples?



Word Web

15 **Create a word web using the term *reasonableness.***



What's in a Word?

TABLE The word *table* has many uses. A *table* can be something you sit at. You could use a *table*cloth, a *table*spoon, and *table*ware. You could play *table* tennis, which is a game like tennis that is played on a table. You could find a chapter title in a *table* of contents. In math, you would use a *table* to show data in rows and columns. A math *table* makes it easier to understand data.

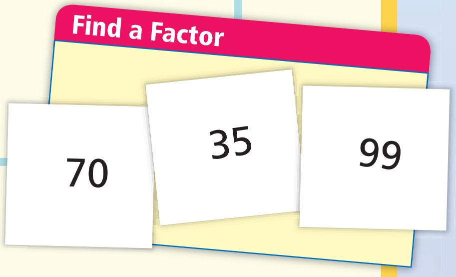
GO ONLINE **Technology**
Multimedia Math Glossary
www.harcourtschool.com/thinkmath

GAME

Find a Factor

Game Purpose
To practice multiplication facts and using fact families

Materials
- Activity Master 48: *Product Cards*
- Activity Master 49: *Factor Cards*



How To Play The Game

1 This is a game for 4 players. Each group will need one set of Product cards and two sets of Factor Cards.
- Cut out the Product Cards. Mix them up. Put them face down in a pile.
- Cut out the Factor Cards. Mix them up. Give each player 12 cards. Everyone places their cards face up in front of them.

2 Turn over the top Product Card. All players turn face down any of their Factor Cards that are factors of that product.

Example: The Product Card is: 64

José has these Factor Cards in front of him:

6	6	2	11	8	1
9	7	3	12	2	6

José turns over all of his Factor Cards that show a factor of 64. Now his cards look like this:

6	6		11		
9	7	3	12		6

3 Turn over the next Product Card and keep playing.

4 The first player to turn all of his of her Factor Cards face down wins! Everyone should check to be sure that the winner's Factor Cards match the Product Cards.

GAME

Profitable Products

Game Purpose
To practice solving simpler problems to complete multi-digit multiplication problems

Materials
- Activity Master 48: *Product Cards*
- Calculator

How To Play The Game

1. Play this game with a partner. Cut out the Product Cards. Mix them up. Put them face down in a pile.
2. Each player picks a card and turns it face up. Use the two numbers as factors in a multi-digit multiplication problem.
3. Decide who will go first.

   Players take turns choosing and calculating a partial product. Each player gets 100 points plus the value of the partial product. You can check each problem with a calculator.
4. Take turns going first for each problem. The first player to score 5,000 points wins!

   Example: Reena and Ken are using these Product Cards: 42 54

   These are the partial products:

   $40 \times 50 = 2{,}000$ $\quad 40 \times 4 = 160$ $\quad 2 \times 50 = 100$ $\quad 2 \times 4 = 8$

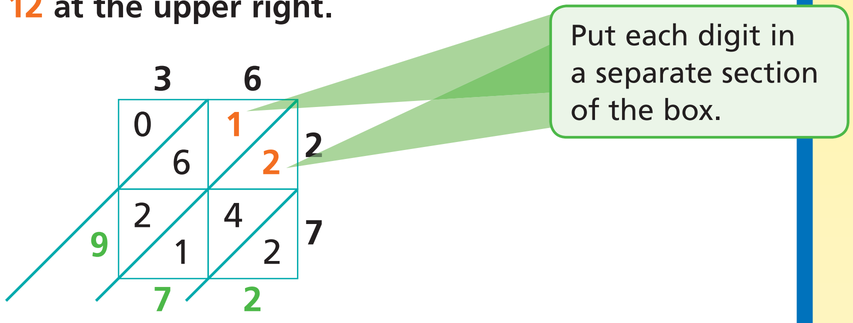
   Reena goes first. She chooses $40 \times 50 = 2{,}000$. So, she gets $100 + 2{,}000 = 2{,}100$ points.

CHALLENGE

There are many ways of multiplying. Here is another way to multiply that you can try. It is called lattice multiplication.

Multiply 36×27.

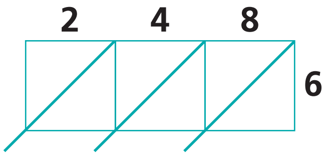
In the grid below, the factors are at the top and on the right. Each space is filled using a multiplication fact. For example, $6 \times 2 = 12$, so write 12 at the upper right.



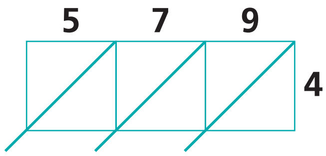
Then add the numbers along the diagonal lines, starting at the bottom right. Regroup if you need to. So, you can read the product of 36 and 27: $36 \times 27 = 972$.

Copy each grid. Use lattice multiplication to find the product.

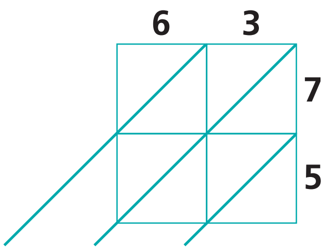
1. 248×6



2. 579×4



3. 63×75



4. 26×59