14 Addition and Subtraction in Depth

Dear Student,

When we need to solve difficult math problems, we sometimes use related problems that are simpler to solve.
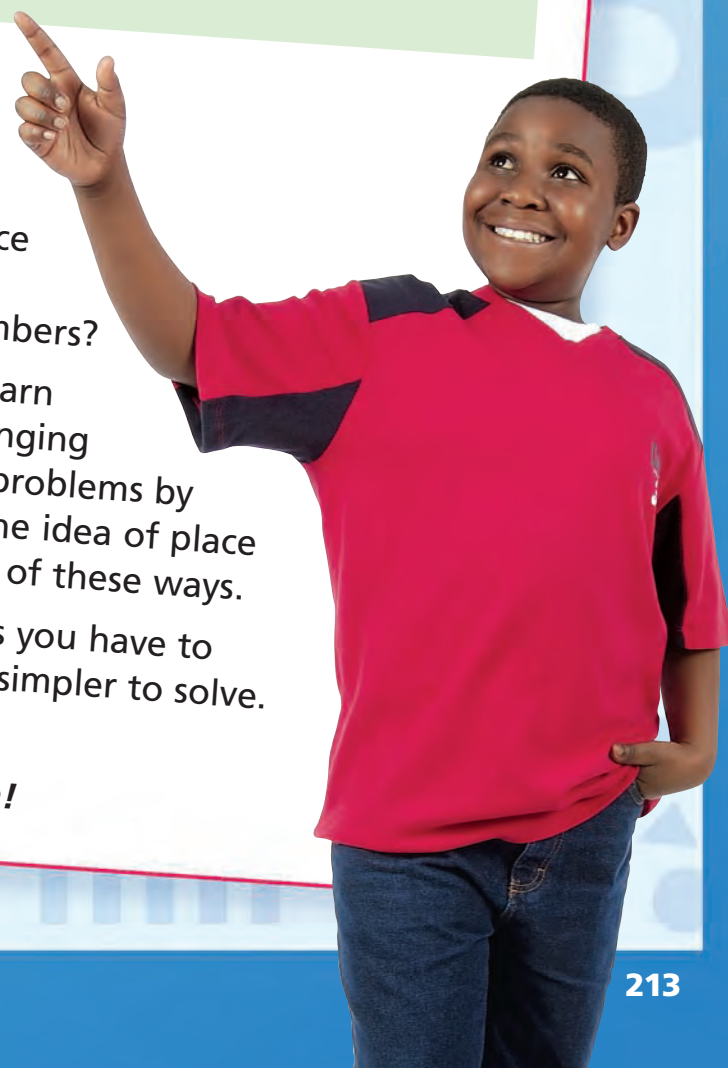
For example, to solve 70,000 + 60,000 = ■, we might use 7 + 6 = ■. How could 7 + 6 = ■ help with 70,000 + 60,000 = ■? Which other problems that involve large numbers could you solve using 7 + 6 = ■?

The idea of place value makes it possible to use 7 + 6 = ■ to complete 70,000 + 60,000 = ■. Can you explain how place value can help you solve problems with larger numbers?

In this chapter, you will learn more ways to solve challenging addition and subtraction problems by using simpler problems. The idea of place value will be at the center of these ways.

So go ahead! Use the tools you have to make "difficult" problems simpler to solve.

Mathematically yours,
The authors of *Think Math!*

THE WORLD ALMANAC FOR KIDS

A Visit to New York City

New York City has the largest population of any city in the United States. Five parts, called boroughs, make up New York City. Two of the boroughs are islands. If you visit the city, you can get around by bus, taxi, subway, car, and even by boat!
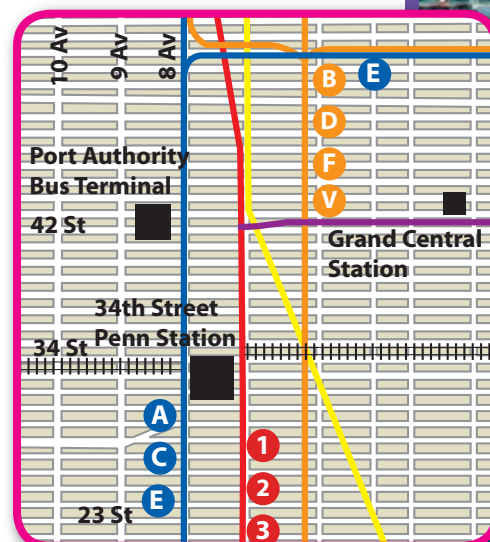
FACT·ACTIVITY 1

Major Transportation Systems in New York City				
Type of Transportation	Buses	Licensed Taxis	Subway Cars	Ferries
Total Number	4,489	12,778	?	5

For 1–4, use the table.

1. What is the place value of the digit 1 in the total number of licensed taxis?

2. Describe the total number of licensed taxis in words.

3. The buses in New York City run 44,550 trips on a daily basis. Write the number of buses and the number of trips in expanded form.

4. The total number of running subway cars is missing from the table. Its thousands digit is 3 times its hundreds digit. Which of the following could be the number of running subway cars: 6,030; 6,200; 620; 2,600?

The subway system has *underground* tracks below street level, street level tracks, *embankment* tracks built up on earth or stone, and elevated tracks built on high platforms above street level.

FACT·ACTIVITY 2

Just for fun, some people try to ride the entire New York subway system in the shortest time possible. In August, 2006, two college students finished the ride in 24 hours 2 seconds!

For 1–3, use the table.

New York City Subway Facts

Type of Stations	Number of Stations
Underground	277
Elevated	?
Embankment	29
Street level	9
TOTAL	468

1 How many underground, embankment, and street level stations are there in all?

2 Find the number of elevated stations.

3 New York subway stations are also famous for their interesting art and designs. Mike wants to see the art in each subway station. He rides to 152 stations on the first day and 137 more stations on the second day. How many more stations are left for Mike to see?

CHAPTER PROJECT

Central Park is a must-see attraction when you visit New York. Create a brochure that includes the area of different parts of the park and the distances to the park from other major attractions. Also include:

- a map of the park
- directions to the park
- interesting facts about the park, such as total number of water fountains, benches, ponds, or species of birds.

Write three 2- and 3-digit addition and/or subtraction sentences based on your facts.

ALMANAC

Fact

There are about 6,375 miles of streets in New York City. There is no street in Manhattan called Main Street.

EXPLORE
Exploring Multi-Digit Addition

1 Make up a situation to go with the problem:

$$163 + 24$$

Write each number in expanded form. Find a way
to use the expanded form to add the numbers.
If it helps, use base-ten blocks or draw a diagram.
Be prepared to explain your solution.

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2 Ruby added a number to **384** and got a sum with a
6 in the tens place.

```
    3 8 4
  + ■ ■ ■
  ─────────
    ■ 6 ■
```

Could her sum be correct? Explain.

REVIEW MODEL
Using Expanded Form to Add

You can break up numbers to add. Breaking up numbers can help you regroup the place values to find the sum.

Example **Find the sum.**

$$365$$
$$+\ 289$$

Step 1 Break up both addends by writing them in expanded form.

$$365 = 300 + 60 + 5$$
$$289 = 200 + 80 + 9$$

Step 2 Add each place value.

$$365 = 300 + 60 + 5$$
$$+\ 289 = 200 + 80 + 9$$
$$= 500 + 140 + 14$$

Step 3 Regroup if there is 10 or more in the ones place.

Rewrite 14 using expanded form: $14 = 10 + 4$

Add the 10 to the tens place. Put the remaining 4 ones in the ones place.

$$365 = 300 + 60 + 5$$
$$+\ 289 = 200 + 80 + 9$$
$$= 500 + 150 + 4$$

Step 4 Regroup if there is 100 or more in the tens place.

Rewrite 150 using expanded form: $150 = 100 + 50$

Add the 100 to the hundreds place. Put the remaining 50 in the tens place.

$$365 = 300 + 60 + 5$$
$$+\ 289 = 200 + 80 + 9$$
$$= 600 + 50 + 4$$

Step 5 Add the sums in each place value to find the total sum.

$$365$$
$$+\ 289$$
$$654$$

✓ Check for Understanding

Find the sum.

1. $78 + 22$

2. $403 + 168$

3. $655 + 267$

4. $248 + 109$

5. $66 + 36$

6. $782 + 235$

EXPLORE
Exploring Multi-Digit Subtraction

Four students broke up **348** in different ways: **348**

Cliff's way:

300 + 40 + 8

Paula's way:

200 + 140 + 8

Sean's way:

200 + 130 + 18

Lana's way:

300 + 30 + 18

For Problems 1 and 2, use base-ten blocks or draw a picture to explain your thinking.

1 Which way is most useful for subtracting **172 from 348?**

2 Which way is most useful for subtracting **89 from 348?**

How would you break up 232 if you were subtracting . . . **232**

3 11?   **4** 96?   **5** 113?

6 Make up a situation to go with one of the subtraction problems on this page. Write a number sentence to go with your story.

REVIEW MODEL
Using Expanded Form to Subtract

You can break up numbers to subtract. Then you can regroup, if necessary, to find the difference.

Example Find the difference.

$$755$$
$$-\ 167$$

Step 1 Write each number in expanded form.

$$755 = 700 + 50 + 5$$
$$167 = 100 + 60 + 7$$

Step 2 Subtract the ones.

Think: $5 < 7$

So, take 10 from the tens place of the larger number and add it to the ones place.

The tens place of the larger number changes from 50 to 40, and the 5 ones become 15 ones.

$$755 = 700 +\ \ 40 + 15$$
$$-\ 167 = 100 +\ \ 60 +\ \ 7$$
$$8$$

Step 3 Subtract the tens.

Think: $40 < 60$

So, take 100 from the hundreds place of the larger number and add it to the tens place.

The hundreds place of the larger number changes from 700 to 600, and the tens place changes from 40 to 140.

$$755 = 600 + 140 + 15$$
$$-\ 167 = 100 +\ \ 60 +\ \ 7$$
$$80 +\ \ 8$$

Step 4 Subtract the hundreds. Then add the numbers in each place value to find the difference.

$$755 = 600 + 140 + 15$$
$$-\ 167 = 100 +\ \ 60 +\ \ 7$$
$$500 +\ \ 80 +\ \ 8 = 588$$

✔ Check for Understanding

Find the difference.

1 $426 - 118$
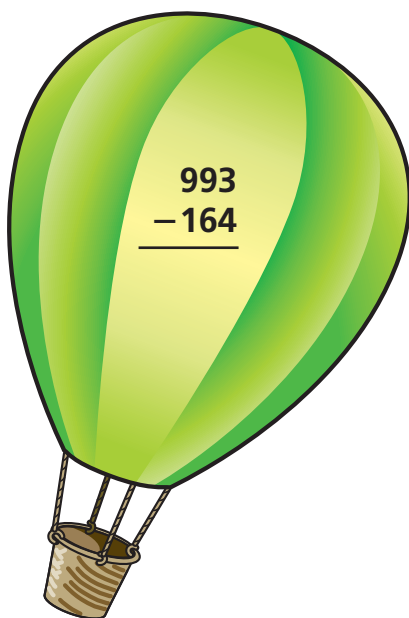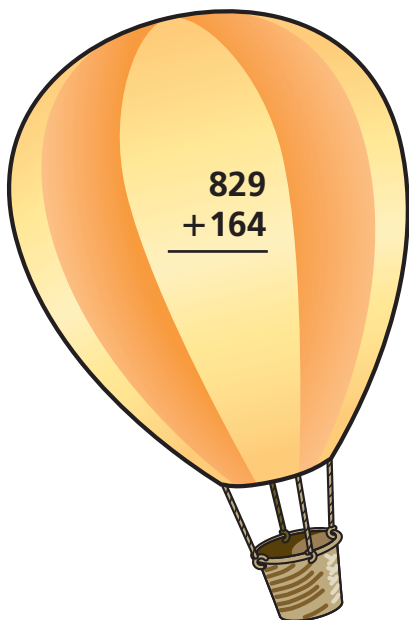
2 $356 - 124$

3 $176 - 29$

4 $142 - 65$

5 $521 - 433$

6 $257 - 183$

EXPLORE
Exploring Addition and Subtraction

How would you break up these numbers to add and subtract?

829
+164

993
−164

EXPLORE
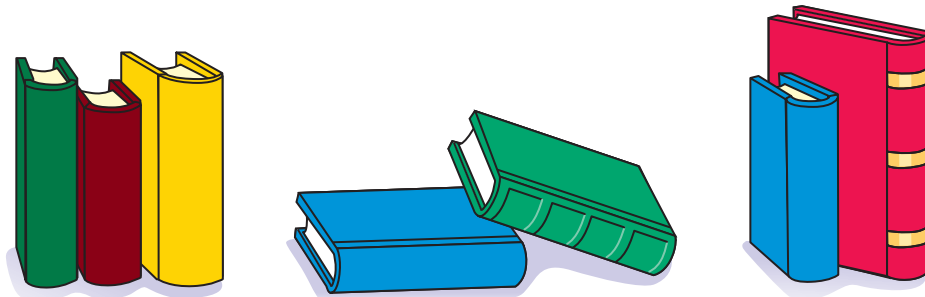# Exploring Situations

David wants to know if there are more science books or biography books in the library.

In the science section, there are 48 books on the first shelf, 65 books on the second shelf, and 77 books on the third shelf.

In the biography section, there are 105 books on the first shelf, 52 books on the second shelf, and 68 books on the third shelf.

1 Which section has more books?

2 How many more books are in that section than in the other?

3 Be prepared to discuss how you solved the problem.

REVIEW MODEL
Problem Solving Strategy
Solve a Simpler Problem

Shanna owns a garden shop. She spent $53 for each small clay pot and sold each one for $80. She spent $112 for each medium clay pot and sold each one for $145. She spent $137 for each large clay pot and sold each one for $170. If Shanna sold one clay pot of each size on one day, how much money did she make that day?

$80 $145 $170

Strategy: Solve a Simpler Problem

Read to Understand

What do you know from reading the problem?

The amount Shanna paid for each size of clay pot and the sale price of each size of pot.

Plan

How can you solve this problem?

You can use the strategy *solve a simpler problem.*

Solve

How can you use this strategy to solve the problem?

Find the amount she made on each size of pot by finding the difference between the amount she paid and the sale price for each pot.

Small clay pot: $80 − $53 = $27

Medium clay pot: $145 − $112 = $33

Large clay pot: $170 − $137 = $33

Then find the total amount she made.

$27 + $33 + $33 = $93   So, Shanna made $93.

Check

Look back at the problem. Did you answer the question that was asked? Does the answer make sense?

Problem Solving Practice

Use the strategy *solve a simpler problem.*

1. Paul is in charge of counting students as they enter and leave the school carnival. He counted 455 students entering before 1:00 P.M. He counted 126 students leaving at 2:00 P.M. At 3:00 P.M., 56 more students arrived and 14 students departed. At 4:00 P.M., 111 students left and 44 students arrived. How many students were at the carnival at 4:00 P.M.?

2. Carrie mows 14 lawns each week. How many lawns does she mow in 9 weeks?

Mixed Strategy Practice

Use any strategy to solve. Explain.

3. What is the missing output?

Input	5	7	3	9	4
Output	14	16	12	18	■

4. What is the mystery number? The number is greater than 40 but less than 50. The number is odd. When you add the two digits together, you get a sum of 13.

5. Rod has 42 stickers to share evenly with his 6 friends. How many stickers will each person get if Rod shares his stickers with his friends and gives himself the same number of stickers?

6. At 5:00 P.M. when the baseball game started, the temperature was 63°F. By 7:00 P.M., it was 8 degrees cooler. By 9:00 P.M., the temperature had dropped another 16 degrees. What was the temperature at 9:00 P.M.?

7. Brooke arranged her picture frames on her bedroom wall in an array with 8 rows and 3 columns. What other ways could she arrange the same number of pictures if she wants to make an array, but does not want to have all the pictures in one row or one column?

8. Mr. Hood plans to work in his garden 12 hours during the next 3 days. He wants to work for half of the planned time on Friday, half of the time that is left on Saturday, and the remaining time on Sunday. How many hours does Mr. Hood plan to work in his garden on Sunday?

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. A number close to an exact amount is a(n) __?__.

2. A(n) __?__ has more than one digit.

3. When you write a number to its nearest ten or hundred you __?__.

4. A number that is added to another in an addition problem is called a(n) __?__.

5. A way to write a number to show the value of each digit is called __?__.

6. To __?__ means to exchange equal amounts when working with a number.

7. The answer in a subtraction problem is called the __?__.

Word List A

addend
compatible numbers
difference
estimate
expanded form
multi-digit number
regroup
round
standard algorithm
sum

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

8. Compatible numbers are to estimate as addends are to __?__.

9. Addition is to subtraction as sum is to __?__.
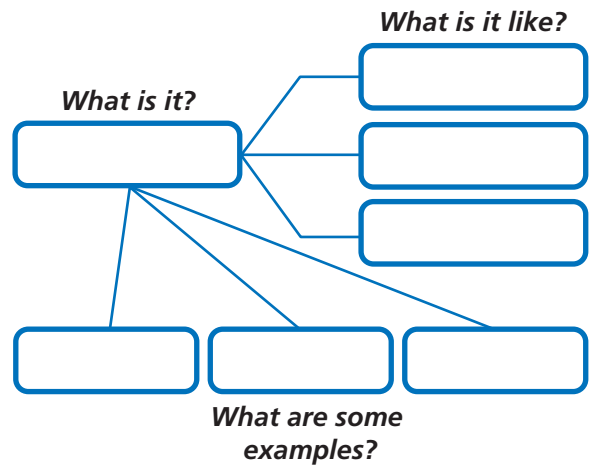
Word List B

difference
estimate
sum

🗨 **Talk Math**

Discuss with a partner what you have learned about addition and subtraction. Use the vocabulary terms *expanded form, regroup, standard algorithm,* and *sum.*

10. How can you add two multi-digit numbers?

11. How can you use sums to 10 to add a list of two-digit numbers?

Word Definition Map
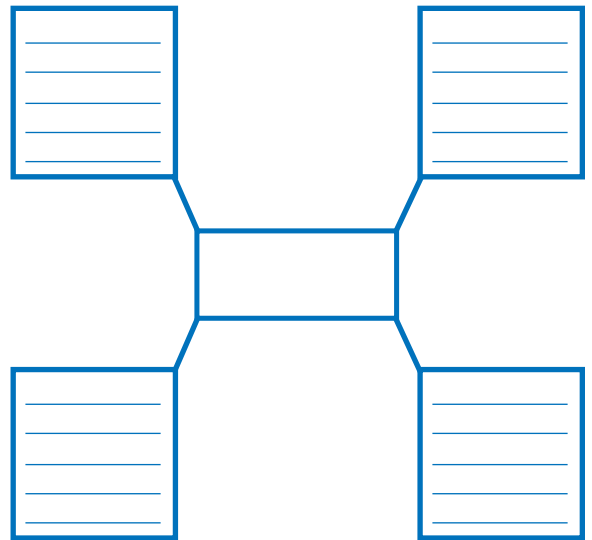
12 **Create a word definition map for the term *estimate*.**

   A What is it?

   B What is it like?

   C What are some examples?

What is it?

What is it like?

What are some examples?

Word Web

13 **Create a word web using the term *sum*.**

What's in a Word?

ESTIMATE This word is spelled one way, but it can be pronounced two ways. When it is a noun (a naming word), the *A* in the last syllable has a short sound. It sounds like the *I* in the middle syllable. "The *estimate* of the sum is 600." The verb (action word) has a long *A* sound in the last syllable. It sounds like the word for friend, *mate.* "*Estimate* the sum of 362 and 231."

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

GAME

Place Value Game

Game Purpose
To practice reading and comparing place values of six-digit numbers

Materials
- Activity Masters 177–184: Attribute Cards
- Scissors

Place Value Game

16,832

ten-thousands digit < 2

Three of the digits are less than 5.

The tens digit is greater than the ten-thousands digit.

How To Play The Game

1 This is a game for 3, 4, or 5 players. The goal is to match 5 six-digit numbers that you choose to attributes on the Attribute Cards. The blue cards are the easiest. The green cards are more challenging. As a group, decide which color cards to use. Or you may use all of the cards.

2 Cut out the Attribute Cards. Mix them up. Place them face down in a stack.

3 Write 5 six-digit numbers on a sheet of paper. Write neatly and large enough for the others to see.

4 Take turns. Turn over one attribute card at a time. Read it aloud. Cross out any of your numbers that match the attribute. You may help one another decide which numbers to cross out.

5 The first player to cross out all 5 numbers wins. If there is time, play another game.
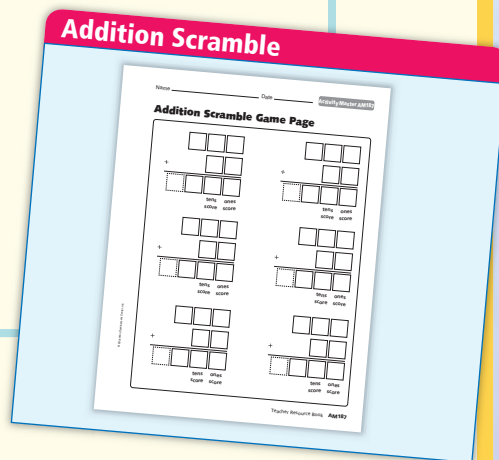
GAME

Addition Scramble

Game Purpose
To practice addition with multi-digit numbers

Materials
- Activity Master 187:
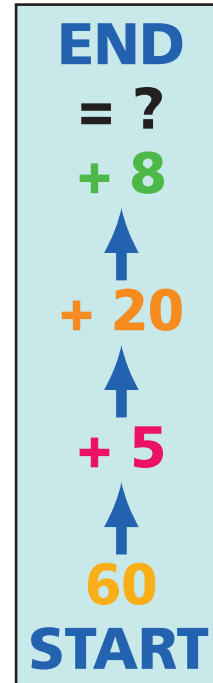 Addition Scramble Game Page
- Number cards (1–9, four sets)

Addition Scramble

How To Play The Game

1 This is a game for 2 players. The goal is to score fewer points. Use the same game page.

2 Mix up the number cards. Place them face down in a stack.
- One player takes 3 cards. He or she puts the cards in any order to make a three-digit number.
- The other player takes 2 cards. He or she makes a two-digit number.
- Both players record their numbers on the Addition Scramble Game Page.

3 Find the sum of the numbers.

4 The first player's score is the digit in the tens place. The second player's score is the digit in the ones place.

5 Trade roles. Keep a running total of your scores. Play until one player reaches 50 points. The other player wins!

CHALLENGE

Solve these ten number puzzles. Work backward from the starting number to find each number. Each puzzle will involve addition, subtraction, or comparisons. Some puzzles might use two of those or all three. The first puzzle is set up for you.

1. What number is 8 more than 20 more than 5 more than 60?
2. What number is 25 more than 9 more than 32 more than 14 more than 18?
3. What number is 3 less than 2 more than 17 more than 11?
4. What number is 5 less than 4 less than 6 less than 59?
5. What number is 12 more than 1 more than 3 less than 25 more than 6?
6. What number is 10 less than 17 more than 6 more than 2 less than 21?
7. What number is 4 more than 15 less than 19 more than 8 less than 52?
8. What number is 9 less than 23 less than 14 more than 16 more than 73?
9. What number is 27 more than 8 less than 16 less than 10 less than 35?
10. What number is 8 less than 13 less than 24 less than 7 less than 86?

END

= ?

+ 8
↑
+ 20
↑
+ 5
↑
60
START

Now make up some number puzzles on your own. Test them out on a partner.

11. Use only addition and at least three comparisons.
12. Use only subtraction and at least three comparisons.
13. Use both addition and subtraction and at least three comparisons.