The Partial-Sums Algorithm

Objectives
To guide children as they make ballpark estimates; and to provide opportunities to model and practice the partial-sums algorithm for 2- and 3-digit numbers.

1. Teaching the Lesson

Key Concepts and Skills
- Model multidigit numbers with base-10 blocks. (Number and Numeration Goal 1)
- Use basic facts to solve extended fact problems with the partial-sums algorithm. (Operations and Computation Goal 1)
- Use base-10 blocks to extend the partial-sums algorithm to 3-digit addends. (Operations and Computation Goal 2)
- Make ballpark estimates as a check for reasonableness of answers. (Operations and Computation Goal 5)

Key Activities
Children add 2- and 3-digit numbers, discuss solution methods, and make ballpark estimates to check addition results.

Ongoing Assessment:
Recognizing Student Achievement
Use journal page 45. (Operations and Computation Goal 2)

Key Vocabulary
partial-sums algorithm; ballpark estimate; rounding; partial-sums method

Materials
Math Journal 1, p. 45
Student Reference Book, pp. 190–194
Home Link 2/6
Math Masters, p. 53 (optional)
base-10 blocks; overhead base-10 blocks (optional)

Advance Preparation
Plan to spend two days on this lesson.

2. Ongoing Learning & Practice

Playing Target: 50
Student Reference Book, pp. 312 and 313
Math Masters, pp. 411 and 465
per partnership: 4 each of number cards 0–9 (from the Everything Math Deck, if available), base-10 blocks
Children practice multidigit addition and subtraction.

Math Boxes 2/7
Math Journal 1, p. 46
Children practice and maintain skills through Math Box problems.

Home Link 2/7
Math Masters, p. 52
Children practice and maintain skills through Home Link activities.

3. Differentiation Options

READINESS
Modeling 2-Digit Numbers with Base-10 Blocks
Math Masters, p. 411
4 each of number cards 0–9 (from the Everything Math Deck, if available); base-10 blocks; half-sheet of paper
Children use base-10 blocks to model 2-digit numbers.

ENRICHMENT
Making Up Addition Problems from a Mileage Map
Student Reference Book, pp. 224 and 225
Math Masters, p. 407
Children make up and solve 3-digit addition number stories based on a mileage map.

ELL SUPPORT
Building a Math Word Bank
Differentiation Handbook, p. 132
Children write the term ballpark estimate using the Word Bank template.
Getting Started

Mental Math and Reflexes
Ask such questions as the following:

- Is 42 closer to 40 or 50? 40
- Is 56 closer to 50 or 60? 60
- Is 95 closer to 90 or 100? Same distance away
- Is 150 closer to 100 or 200? Same distance away
- Is 210 closer to 200 or 300? 200
- Is 998 closer to 900 or 1,000? 1,000
- Is 2,068 closer to 2,000 or 2,100? 2,100
- Is 3,243 closer to 3,240 or 3,250? 3,240
- Is 4,250 closer to 4,200 or 4,300? Same distance away

Math Message
Add.

\[
\begin{align*}
63 + 24 &= 87 \\
28 + 37 &= 65 \\
49 + 18 &= 67
\end{align*}
\]

Home Link 2-6 Follow-Up
Review answers as necessary. Have a few children share their strategies for solving the number stories.

1 Teaching the Lesson

Math Message Follow-Up
Ask children how they calculated the answers. Record children’s different strategies on the board. During the discussion, have children name the value in each place, not just the digits. In the first problem, for example, if a child says, “I added the 6 and the 2” remind the class to say they added 60 and 20, or 6 tens and 2 tens.

Possible Strategies for 28 + 37

- 20 + 30 = 50; 8 + 7 = 15; and 50 + 15 = 65. This strategy uses the partial-sums algorithm.
- Take 2 from 37, getting 35, and add the 2 to 28; 28 + 2 = 30, and 30 + 35 = 65.
- Think of 37 as 30 + 7; 28 + 7 = 35; and 35 + 30 = 65.

Making Ballpark Estimates
(Student Reference Book, pp. 190–193)
Remind children that answers should always be checked to see whether they make sense. This is true for number story problems and for problems where there is no story like those in the Math Message.

Children should make a ballpark estimate of an answer either before or after calculating to help solve a problem or check an answer. One way to make an estimate is by changing the numbers in a problem to close-but-easier numbers and then adding or subtracting them. Have children read about estimation on pages 190–193 in the Student Reference Book.
Ask children to make ballpark estimates for the problems below and tell how they arrived at their estimates. Note that there is often more than one acceptable estimate.

- $42 + 89$ is close to $40 + 90 = 130$
- $23 + 71$ is close to $20 + 70 = 90$
- $148 + 51$ is close to $150 + 50 = 200$
- $213 + 468$ is close to $200 + 500 = 700$ or $210 + 470 = 680$
- $35 + 63$ is close to $30 + 60 = 90$ or $40 + 60 = 100$. Point out that because 35 is halfway between 30 and 40 on the number line, either 30 or 40 may be used as an easier substitute for 35.

**Rounding to the Nearest 10 or 100**

*(Student Reference Book, p. 194)*

**Rounding** can also help you estimate. We round numbers to make them easier to work with or understand. Numbers are often rounded to the nearest 10, 100, 1,000, and so on. For example, 769 rounded to the nearest 100 is 800.

The following describes three methods for rounding numbers.

**Three Methods for Rounding**

**Method 1**

Write the following table on the board.

<table>
<thead>
<tr>
<th>Four Tallest Buildings in the United States in 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building</strong></td>
</tr>
<tr>
<td>Willis Tower (formerly Sears Tower), Chicago</td>
</tr>
<tr>
<td>Trump International Hotel &amp; Tower, Chicago</td>
</tr>
<tr>
<td>Empire State Building, New York</td>
</tr>
<tr>
<td>Bank of America Tower, New York</td>
</tr>
</tbody>
</table>

Ask: *How many floors does the Bank of America Tower in New York have?* 54 As a class, work through the number-line method to round 54 to the nearest ten.

1. **Draw the following number line on the board.**
2. Ask which two multiples of 10 are closest to 54. Have children skip count by 10s to help them decide. 10, 20, 30, 40, 50, 60, 70, … Help them conclude that since 54 is between the multiples of 50 and 60, they are the closest multiples. Record 50 and 60 on the number line.

Ask a volunteer to write the number that is halfway between the lower and higher numbers on the number line. 55

3. Invite another volunteer to mark the approximate location of 54 on the number line.

4. Ask: Is 54 closer to the lower number or to the higher number? Lower number What is 54 rounded to the nearest ten? 50

Draw another number line and say: Use the number-line method to round the number of floors in the Trump International Hotel & Tower to the nearest 10. 90 floors

Method 2
As a class, read and discuss another method for rounding on Student Reference Book, page 194. Using this method, what would be the height of the Trump International Hotel & Tower rounded to the nearest hundred feet? 1,400 feet

1. Write the number you are rounding. Underline the digit in the place to which you are rounding. 1 3 8 9

2. Replace all digits to the right of the underlined digit with 0. This is the lower number. 1 3 0 0

3. Add 1 to the underlined digit and leave the digits to the right as 0. This is the higher number. 1 4 0 0

4. Ask yourself: Is the number I am rounding closer to the lower number or the higher number?

5. Round to the closer of the two numbers. 1 4 0 0

Method 3
The third rounding method uses reasoning to compress the steps of the previous methods. Consider rounding 54 to the nearest 10.

1. Write the number and underline the digit in the place to which you are rounding. 5 4

2. Look at the digit to the right of the place to which you are rounding. 5 4

3. If that digit is less than 5, round down. If that digit is equal to or greater than 5, round up. 5 0
Explain to children that when they round down, the digit in the place they are rounding to stays the same. When they round up, the digit they are rounding to increases by 1. Ask children to use Method 3 to find the height of the Willis Tower rounded to the nearest hundred. 1,500 feet.

Have partnerships choose any method and work through the Check Your Understanding problems at the bottom of Student Reference Book, page 194. Bring the class together to share solution strategies.

**Modeling the Partial-Sums Method for 3-Digit Addends**

*(Math Masters, p. 53)*

Remind children that in Second Grade Everyday Mathematics they used the partial-sums method to add 2- and 3-digit addends. Today you will review how the partial-sums method works with 3-digit addends.

Write these problems on the board in vertical form:

```
  145
+ 322
```

Ask children to gather in a circle as you demonstrate with base-10 blocks, or use base-10 blocks on the overhead projector. Refer to flats as hundreds, longs as tens, and cubes as ones. For each problem, model addition as a four-part operation: add the 100s, add the 10s, add the 1s, and then add the partial sums.

**Example 1:** Model 145 + 322 with base-10 blocks.

- Count out 1 flat, 4 longs, and 5 cubes to represent 145. Count out 3 flats, 2 longs, and 2 cubes to represent 322.
- Arrange the blocks like the addition problem in vertical form.
- Gather the hundreds into one pile, the tens into a second pile, and the ones into a third pile.
- Count the hundreds. 4 hundreds, or 400 Count the tens. 6 tens, or 60 Count the ones. 7 ones, or 7
- Add the hundreds, tens, and ones. 400 + 60 + 7 = 467
- Ask children how they would record this procedure on paper. You may use Math Masters, page 53 if you wish.

```
          |   |   |
  145     | 1 | 4 | 5
+ 322     | 3 | 2 | 2
          | 4 | 0 | 0
          | 6 | 0 |
          | 4 | 6 | 7
```

Algorithm Project The focus of this lesson is the partial-sums method. To teach U.S. traditional addition, see Algorithm Project 1 on page A1.
Make a ballpark estimate. Write a number model to show your estimate.

Example:

Add the partial sums.

Add the 1s.

L 300

2

+ R 110

1

1

100s 10s 1s

1 6 9

+ 1 7 5

1. Add the 100s.
2. Add the 10s.
3. Add the 1s.
4. Add the partial sums.

Example 2: Model 169 + 175 with base-10 blocks.

Count out and arrange the blocks as before. Gather the hundreds, tens, and ones into separate piles.

Children might notice that the 13 tens can be replaced by 1 hundred and 3 tens. The 14 ones can be replaced by 1 ten and 4 ones. Make these substitutions, but leave the 1 hundred and 3 tens in the tens pile, and leave the 1 ten and 4 ones in the ones pile.

Add the hundreds, tens, and ones: 200 + 130 + 14 = 344.

Show children how to record this procedure on paper.

Try more 3-digit addition problems as needed.

Practicing the Partial-Sums Algorithm and Other Addition Methods

(Math Journal 1, p. 45; Math Masters, p. 53)

Children should show their work on the journal page. Remind them to make ballpark estimates for checking their answers and for finding mistakes if an answer seems unreasonable. Provide base-10 blocks for children to use. Children may share their answers with a partner. If there is a disagreement, encourage them to discuss their strategies with each other and do the problem again until they both can agree on an answer. Abundant practice will be found on Home Link and Math Boxes pages in future lessons. Additional problems may be created on Math Masters, page 53.

Ongoing Assessment: Recognizing Student Achievement

Use journal page 45, Problems 1 and 2, to assess children’s ability to solve multidigit addition problems. Children are making adequate progress if they are able to solve Problems 1 and 2 correctly, with or without the use of manipulatives. Some children may be able to solve the rest of the problems on the page, with or without manipulatives.

[Operations and Computation Goal 2]
**Ongoing Learning & Practice**

### Playing Target: 50

(Student Reference Book, p. 312; Math Masters, pp. 411 and 465)

Children practice multidigit addition and subtraction with base-10 blocks by playing Target: 50. Go over the rules for Target: 50 on page 312 in the Student Reference Book.

**NOTE** The Target: 50 Record Sheet on Math Masters, page 465 may be used as an assessment tool. Have children record one series of turns taken to reach 50.

### Math Boxes 2-7

(Math Journal 1, p. 46)

**Mixed Practice** Math Boxes in this lesson are linked with Math Boxes in Lessons 2-5 and 2-9. The skill in Problem 6 previews Unit 3 content.

**Writing/Reasoning** Have children write an answer to the following: Explain how you found the length of the fence in Problem 6. Sample answer: I added all of the sides.

### Home Link 2-7

(Math Masters, p. 52)

**Home Connection** Children solve addition problems using 2- and 3-digit numbers. Since the partial-sums algorithm might not be familiar to parents, you might want to send home the Student Reference Book.
3 Differentiation Options

**READINESS**

▶ Modeling 2-Digit Numbers with Base-10 Blocks

*(Math Masters, p. 411)*

To explore place-value concepts using a concrete model, have children build numbers with base-10 blocks. Children draw two cards and place them on a Place-Value Mat to make a 2-digit number. They put longs in the tens column to show the tens digit and cubes in the ones column to show the ones digit. On a half-sheet of paper, children draw a picture to show what they did. They write the number in standard notation and in expanded notation under the picture. *(See margin.)*

**ENRICHMENT**

▶ Making Up Addition Problems from a Mileage Map

*(Student Reference Book, pp. 224 and 225; Math Masters, p. 407)*

**Social Studies Link** To apply children’s understanding of addition, have them write and solve addition number stories. Children study the U.S. mileage map in the *Student Reference Book*, on pages 224 and 225. Pose problems like the following to be sure that children understand how to read the map.

- Find Minneapolis, Minnesota. Which city on the map is 501 miles from Minneapolis? Bismarck, North Dakota
- Find Seattle, Washington. How would you determine the number of miles from Seattle to Salt Lake City, Utah, by way of Boise, Idaho? Add the distance from Seattle to Boise to the distance from Boise to Salt Lake City. Children pose new addition problems to each other using the mileage map. Children may record one or two of their stories on *Math Masters*, page 407.

**ELL SUPPORT**

▶ Building a Math Word Bank

*(Differentiation Handbook, p. 132)*

To provide language support for estimation, have children use the Word Bank template found on *Differentiation Handbook*, page 132. Ask children to write the term *ballpark estimate*, draw a picture representing the term, and write other related words. See the *Differentiation Handbook* for more information.