Addition of Multidigit Numbers

Objectives: To review the partial-sums algorithm used to solve multidigit addition problems; and to introduce a column-addition method similar to the traditional addition algorithm.

Key Concepts and Skills
- Identify places in whole numbers and the values of the digits in those places. [Number and Numeration Goal 1]
- Apply extended addition facts. [Operations and Computation Goal 1]
- Use the partial-sums and column-addition algorithms to solve multidigit addition problems; choose an appropriate paper-and-pencil algorithm to solve multidigit addition problems. [Operations and Computation Goal 1]
- Make ballpark estimates for multidigit addition problems. [Operations and Computation Goal 2]

Key Activities
Students make ballpark estimates for addition problems. They use the partial-sums and column-addition methods for addition.

Ongoing Assessment: Recognizing Student Achievement
Use journal page 42. [Operations and Computation Goal 2]

Key Vocabulary
partial-sums method • column-addition method • ballpark estimate

Materials
Math Journal 1, pp. 42 and 43
Student Reference Book, pp. 10 and 11
Study Link 2-6
Math Masters, p. 403 or 404 (optional)
quarter-sheet of paper • base-10 blocks (optional)

Advance Preparation
Plan to spend a total of two days on this lesson. Place quarter-sheets of paper near the Math Message. If students need computation grids in Part 1, make copies of Math Masters, page 403 or 404.

Getting Started

Mental Math and Reflexes
Poso extended addition-facts problems. Suggestions:

- $50 + 50 = 100$
- $300 + 300 = 600$
- $400 + 100 = 500$
- $2,000 + 6,000 = 8,000$
- $60 + 70 = 130$
- $200 + 700 = 900$
- $3,000 + 8,000 = 11,000$
- $70,000 + 30,000 = 100,000$
- $900 + 400 = 1,300$
- $6,000 + 5,000 = 11,000$
- $90,000 + 80,000 = 170,000$
- $70,000 + 50,000 = 120,000$

Math Message
Solve the problems on a quarter-sheet of paper. Show your work.

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<td>+ 37</td>
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<td></td>
<td>83</td>
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<tr>
<td>233</td>
<td>+ 158</td>
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<td>391</td>
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Study Link 2-6 Follow-Up
Have partners compare answers. Ask students to share the estimated time they spend watching TV each week. Have them compare their estimates to $20\frac{1}{2}$ hours, the average viewing time reported by the World Almanac 2004 for children 2–11 years old.

Links to the Future
In Unit 4 of Fourth Grade Everyday Mathematics students apply these addition algorithms to decimal numbers.

1 Teaching the Lesson

Math Message Follow-Up

Have students share their solution strategies. Tell them that in this lesson they will review the partial-sums method and explore the column-addition method. To support English language learners, explain the meaning of the word partial. Some students may have used these algorithms to solve the Math Message problems.

Making Ballpark Estimates

Remind students that they should always check their answers to see whether they make sense. This is true for number stories and for computation problems like those in the Math Message.

Whether done in advance or as a final check, it is often desirable to make a rough ballpark estimate of the answer. One way to estimate a sum is to change the addends to “close-but-easier” numbers and then add them. To support English language learners, discuss the mathematical as well as the everyday meanings of the terms ballpark and estimate.

Ask students to give ballpark estimates rather than exact answers for sums. (See examples on page 121.) Have them tell how they arrived at their estimates. Encourage students to use terms such as closer to, between, and a little more than to refine their estimates. Note that often more than one estimate is acceptable.
Sample answers:
- $44 + 87 = 121; 40 + 90 = 130; 50 + 80 = 130; 50 + 90 = 140$
- $23 + 77 = 100; 30 + 70 = 100$
- $147 + 56 = 210; 140 + 50 = 190$
- $342 + 281 = 623; 300 + 300 = 600$
- $459 + 809 = 1250; 500 + 800 = 1300$

Discussing and Practicing the Partial-Sums Method for Addition

(Student Reference Book, p. 10; Math Journal 1, p. 42)

The partial-sums method (algorithm) for addition was introduced in *Second Grade Everyday Mathematics*. Discuss the example of the partial-sums method that appears on page 10 of the *Student Reference Book*. It involves more steps than some standard algorithms, but it is also more explicit; for this reason, it might be easier to use. Addition is performed from left to right and column by column. The sum of each column is recorded on a separate line. The partial sums can be added following each step or at the end.

**NOTE** Addition by the partial-sums method can be performed from right to left. The advantage of working from left to right is that this is consistent with the “methods.” Such algorithms are not necessarily the most efficient, but they are easy to use, and they reveal important underlying concepts.

Write several 2-digit and 3-digit addition problems on the board. Have volunteers use and describe the partial-sums method to solve these problems. Remind students that the value of each digit is determined by its place in the numeral. Thus, they should keep in mind what numbers they are adding. For example, in the first problem below, they should think “$40 + 30$,” not “$4 + 3$”; in the second problem, they should think “$200 + 100$,” not “$2 + 1$,” and “$30 + 50$,” not “$3 + 5$.”

### Addition Using the Partial-Sums Method

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<tbody>
<tr>
<td>46</td>
<td>+ 37</td>
</tr>
<tr>
<td>Add the 10s:</td>
<td>40 + 30 → 70</td>
</tr>
<tr>
<td>Add the 1s:</td>
<td>6 + 7 → + 13</td>
</tr>
<tr>
<td>Add the partial sums:</td>
<td>70 + 13 → 83</td>
</tr>
</tbody>
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<tbody>
<tr>
<td>233</td>
<td>+ 158</td>
</tr>
<tr>
<td>Add the 100s:</td>
<td>200 + 100 → 300</td>
</tr>
<tr>
<td>Add the 10s:</td>
<td>30 + 50 → 80</td>
</tr>
<tr>
<td>Add the 1s:</td>
<td>3 + 8 → + 11</td>
</tr>
<tr>
<td>Add the partial sums:</td>
<td>300 + 80 + 11 → 391</td>
</tr>
</tbody>
</table>

Algorithm Project

The focus of this lesson is the partial-sums and column-addition algorithms for addition. To teach U.S. traditional addition, see Algorithm Project 1 on page A1.

**NOTE** An algorithm is a step-by-step set of instructions for solving a problem. In classroom discussion, simply refer to algorithms as “methods.” The partial-sums algorithm is an example of what is sometimes called a “low-stress” algorithm. Such algorithms are not necessarily the most efficient, but they are easy to use, and they reveal important underlying concepts.

**Adjusting the Activity**

Have base-10 blocks readily available for students to use while solving the addition problems.

**Student Page**

**Whole Numbers**

**Addition Methods**

- **Partial-Sums Method**
  - The partial-sums method is used to find sums mentally or with paper and pencil. Here is the partial-sums method for adding 2-digit or 3-digit numbers:
  1. Add the 10s.
  2. Add the 1s.
  3. Add the 10s again.
  4. Then add the tens you just found (the partial sums).

**Example**

Add 248 + 187 using the partial-sums method.

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<table>
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<tbody>
<tr>
<td>10s</td>
<td>1s</td>
</tr>
<tr>
<td>248</td>
<td>187</td>
</tr>
<tr>
<td>Add the 10s:</td>
<td>200 + 100 = 300</td>
</tr>
<tr>
<td>Add the 1s:</td>
<td>8 + 7 = 15</td>
</tr>
<tr>
<td>Add the partial sums:</td>
<td>300 + 15 = 315</td>
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</table>

Use base-10 blocks to show the partial-sums method.

**Example**

Use base-10 blocks to add 248 + 187.

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<tbody>
<tr>
<td>10s</td>
<td>1s</td>
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<tr>
<td>248</td>
<td>187</td>
</tr>
<tr>
<td>Add the 10s:</td>
<td>200 + 100 = 300</td>
</tr>
<tr>
<td>Add the 1s:</td>
<td>8 + 7 = 15</td>
</tr>
<tr>
<td>The total:</td>
<td>300 + 15 = 315</td>
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<tbody>
<tr>
<td>248</td>
<td>187</td>
</tr>
<tr>
<td>Add the 10s:</td>
<td>200 + 100 = 300</td>
</tr>
<tr>
<td>Add the 1s:</td>
<td>8 + 7 = 15</td>
</tr>
<tr>
<td>The total:</td>
<td>300 + 15 = 315</td>
</tr>
</tbody>
</table>

**Student Reference Book, p. 10**

Lesson 2-7
Ask students to turn to journal page 42. Have computation grids available (Math Masters, page 403 or 404) for those students who prefer to use them to help keep the digits in the proper columns. Assign Problems 1–7 for students to complete on their own.

Have students share their solutions to Problem 7 and indicate thumbs-up if they agree with an answer.

### Discussing and Practicing the Column-Addition Method

**Column-Addition Method**

The column-addition method can be used to find sums with paper and pencil, but it is not a good method for finding sums mentally. Here is the column-addition method for adding 2-digit or 3-digit numbers.

1. Draw lines to separate the 1s, 10s, and 100s places.
2. Add the numbers in each column. Write each sum in its column.
3. If there are 2 digits in the 10s places, trade 10 tens for 1 hundred.
4. If there are 2 digits in the 1s place, trade 10 ones for 1 ten.

#### Example

Add 248 and 135 using the column-addition method.

<table>
<thead>
<tr>
<th></th>
<th>100s</th>
<th>10s</th>
<th>1s</th>
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</thead>
<tbody>
<tr>
<td>248</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>135</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Add the numbers in each column:

- 2 + 1 = 3 (in the 100s column)
- 4 + 3 = 7 (in the 10s column)
- 8 + 5 = 13 (in the 1s column)

Move the 1 in the 1s column to the 10s column.

Write the 13 in the 10s column.

**Sum:** 373

#### Larger numbers with 4 or more digits are added the same way.

Write several 2-digit and 3-digit addition problems on the board. Have volunteers use and describe the column-addition method to solve these problems.

Before students solve each problem, ask for and record ballpark estimates.
Ask students to solve Problems 1–3 on journal page 43, using the column-addition method. They can do the remaining problems using any method they choose. Bring small groups of students together to share solutions.

**Adjusting the Activity**
Have students use base-10 blocks to model the meaning of trading in the context of addition.

**AUDITORY • KINESTHETIC • TACTILE • VISUAL**

### 2 Ongoing Learning & Practice

#### Playing High-Number Toss
*(Student Reference Book, p. 252; Math Masters, p. 487)*

Students play *High-Number Toss* to practice comparing numbers.

#### Adjusting the Activity
Have students play *High-Number Toss* in groups of three or more to practice ordering numbers. Have them adjust the scoring accordingly.

**AUDITORY • KINESTHETIC • TACTILE • VISUAL**

#### Math Boxes 2-7
*(Math Journal 1, p. 44)*

**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 students write a response to the following: Shaneel said, “I can draw a rhombus, rectangle, square, or kite for Problem 4.” Do you agree or disagree? 

*Explain your answer.* Sample answer: I disagree. A parallelogram has two pairs of parallel sides. A rhombus, rectangle, and square have two pairs of parallel sides, but a kite doesn’t have any parallel sides.

### Student Page

#### Math Journal 1, p. 43

**Math Boxes 2-7**
*(Math Journal 1, p. 44)*

**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 students write a response to the following: Shaneel said, “I can draw a rhombus, rectangle, square, or kite for Problem 4.” Do you agree or disagree? 

*Explain your answer.* Sample answer: I disagree. A parallelogram has two pairs of parallel sides. A rhombus, rectangle, and square have two pairs of parallel sides, but a kite doesn’t have any parallel sides.
# Study Link 2.7

(Math Masters, pp. 57 and 58)

**Home Connection** Students solve addition problems and show someone at home how to use the methods they used in this lesson. Note that this Study Link consists of two pages—students use the partial-sums method on the first page and the column-addition method on the second page.

### 3 Differentiation Options

**READINESS**

### Solving Addition Number Stories

(Math Masters, pp. 59 and 405)

To explore solving addition problems using a concrete model, have students solve parts-and-total number stories using base-10 blocks and Math Masters, page 405. For each number story, students put base-10 blocks in each of the Part sections, then move the Parts into the Total section to solve the problem.

**Example:**

The class had 43 blue crayons and 15 red crayons. How many crayons did they have in all? Students first put 4 longs and 3 cubes in one of the Part sections and 1 long and 5 cubes in the other Part section. To solve the problem, they move all of the base-10 blocks to the Total section.

### Sample estimates:

Instead of Math Masters, page 405, consider using paper dinner plates divided into three sections. Label each of the two smaller sections Part and the larger section Total.

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## Practice

### Multidigit Addition

Make a ballpark estimate. Use the partial-sums method to add. Compare your answer with your estimate to see if your answer makes sense.

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Sample estimates:

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<td>160</td>
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### Multidigit Addition (continued)

Make a ballpark estimate. Use the column-addition method to add. Compare your answer with your estimate to see if your answer makes sense.

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<tbody>
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<td>1.</td>
<td>66</td>
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<td></td>
<td>150</td>
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Sample estimates:

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Writing Addition Number Stories

To apply students’ understanding of addition algorithms, have them write and solve addition number stories. Then have them record a number model using a letter for the unknown. Encourage students to write multistep number stories. Stories may look similar to the following:

- Ian is shelving books in the library. He shelves 25 science fiction books, 18 biographies, and 36 mystery books. How many books did he shelve in all? Answer: 79 books; Number model: \(25 + 18 + 36 = b\)

Some students may be interested in writing and solving problems that involve distances, intervals of time, liquid volumes, masses of objects, or money. Stories may look similar to the following:

- Kendra bought some school supplies. She spent $1.75 on folders, $2.40 on pens, and $3.80 on notebooks. How much did she spend in all? Answer: $7.95; Number model: $1.75 + $2.40 + $3.80 = c

- Marco wanted to make three different kinds of cookies for the school bake sale. The first recipe called for \(\frac{2}{3}\) cups of milk. The second called for \(\frac{1}{2}\) cup of milk. The last called for \(\frac{1}{3}\) cups of milk. How much milk did Marco need in all? Answer: \(\frac{45}{6}\) cups of milk; Number model: \(\frac{2}{3} + \frac{1}{2} + \frac{1}{3} = m\)

Provide opportunities for students to revise and share their writing. Then have partners solve each other’s problems.

Building a Math Word Bank

(Differentiation Handbook, p. 140)

To provide language support for estimation, have students use the Word Bank Template found on Differentiation Handbook, page 140. Ask students to write the term “ballpark estimate,” draw a picture representing the term, and write other related words. See the Differentiation Handbook for more information.

Planning Ahead

For Part 3 in Lesson 2-8, you will need several baseball caps with adjustable headbands—one cap to be used by each small group of students. Ask students to bring baseball caps to school if they can. To be on the safe side, bring in one or more caps.
Addition Number Stories

Use Math Masters, page 405 and base-10 blocks to solve the number stories. Record what you did in the parts-and-total diagrams.

Example:
The class had 43 blue crayons and 15 red crayons.
How many crayons did they have in all?

```
58 crayons
```

1. Auntie May had 24 fish and 11 hamsters. How many pets did she have altogether?

```
_____ pets
```

2. Jordan made a flower basket for his mother that had 23 daisies and 8 roses. How many flowers were in the basket?

```
_____ flowers
```

3. Lucia had 38 cents and Madison had 29 cents. If they put their money together, how much money would they have?

```
_____ cents
```

4. Miguel has 54 baseball cards. Janet gave him 47 more baseball cards. How many baseball cards does he have now?

```
_____ baseball cards
```