Sadlier School

The Evidence Basis Behind Sadlier Math™ | Grades K–6

Contents

Introduction

The instructional and programmatic features of *Sadlier Math* were built to develop mathematically proficient students by supporting the findings and recommendations of:

- The National Mathematics Advisory Panel (NMAP) in the areas of Curricular Content, Learning Process, Instructional Practices, and Assessment of Mathematics Learning
- The Shifts in Mathematics (focus, coherence, and rigor) as defined by the Student Achievement Partners (www.achievethecore.org), Common Core State Standards (CCSS), and the Publisher's Criteria
- The National Council of Teachers of Mathematics (NCTM) Principles and Standards

Curricular Content

NMAP Findings & Recommendations	How Addressed in *Sadlier Math*
Focused, coherent progression of mathematics learning, with an emphasis on proficiency with key topics, should become the norm in elementary and middle school mathematics curricula. (p. xvi) The mathematics curriculum in Grades PreK–8 should be streamlined and should emphasize a well-defined set of the most critical topics in the early grades. (p. xiii)	The table of contents of each grade level is organized around a focused, coherent group of mathematical topics to help build students' understanding of key skills and concepts. Lessons at each grade level focus on the Benchmarks for the Critical Foundations of the grade levels as defined by NMAP and the National Council of Teachers of Mathematics (NCTM) Curriculum Focal Points. *Learning Progression* charts in **About the Chapter** in the Teacher's Editions describe how skills and concepts are developed within and across grade levels.

A Coherent Progression of Skills

Across the Grade Levels

Within a Grade Level

GRADE 3
Chapter 9 Fraction Concepts

GRADE 4
Chapter 12 Fractions: Multiply by a Whole Number

GRADE 5
Chapter 8 Fractions: Multiplication

Curricular Content *(continued)*

CHAPTER 4

Multiplication Concepts

About the Chapter

In this chapter, students extend their study of multiplication as they explore the Essential Question: How can place-value models help you multiply? They will learn about properties of multiplication, representing products with place-value models, and basic computations as they move towards multidigit multiplication in upcoming chapters.

The table shows the coherence and progression of growth in work with multiplication across the third- through fifth-grade span.

Learning Progression

Grade 3	Grade 4	Grade 5
Develop the concept of multiplication. Fluently multiply within 100. Multiply 1-digit numbers by tens.	Multiply a 1-digit number and a 2-, 3-, or 4-digit number or multiply two 2-digit numbers.	Fluently multiply multidigit numbers. Multiply decimals to hundredths.
Use place value to round whole numbers to the nearest 10 or 100.	Use place value to round numbers to different places and use these to estimate products.	Use place value to round decimals to different places and use these to estimate products.
Learn the Commutative, Associative, and Distributive Properties of Multiplication.	Learn and apply properties of multiplication to extend multiplication to multidigit numbers.	Write expressions with grouping symbols and perform order of operations.
Interpret products of whole numbers.	Write multiplicative comparisons as equations.	Interpret multiplication as scaling (resizing).

Teaching Tips and Practices

- In the next two chapters, students will learn how to multiply multidigit numbers. It is critical that they understand the Distributive Property to do this, as well as multiplication by tens, hundreds, and thousands. It is a combination of these skills that leads to the general algorithm for multiplication.
- Place-value models are used throughout the chapter. To support these, you can use a variety of visual models, such as base ten blocks and place-value charts, so that students will achieve the understanding of the concepts that underlie multidigit multiplication.
- Area models can be used to compare actual products to estimated products. Students will be able to see that the error in the approximation is the difference in the areas.

STEAM Connections

- Students will explore consumer packaging and apply multiplication concepts. Without computing volumes, they will compare rectangular prisms and determine how many smaller boxes can be packed in a shipping box. They will use place-value models, the Distributive Property, and estimation strategies to answer packing questions. (NGSS 5)

Learning Process

NMAP Findings & Recommendations	How Addressed in *Sadlier Math*
To prepare students for Algebra, the curriculum must simultaneously develop conceptual understanding, computational fluency, and problem-solving skills. (p. xix) Use should be made of what is clearly known from rigorous research about how children learn, especially by recognizing the mutually reinforcing benefits of conceptual understanding, procedural fluency, and automatic (i.e., quick and effortless) recall of facts. (p. xiv)	Skills and concepts are taught through a consistent 3-step lesson design (**Develop Concepts**, **Use the Student Pages**, **Summarize**), which provides routine opportunities with fluency practice, concept development, application problems, and daily formative assessment opportunities. Skills and concepts are developed using Concrete-Pictorial-Abstract presentations to ensure students have a thorough understanding of mathematics. Step 1, **Develop Concepts**, the concrete presentation, activates students' prior knowledge and builds foundational understanding of concepts that are new and more complex. Mathematical skills/concepts are introduced through the use of models and virtual manipulatives to help students visualize math and make connections. Manipulatives help students become active learners, make connections, and develop conceptual understanding. Step 2, **Use the Student Pages**, the pictorial and abstract presentations, provides guidance to support explicit step-by-step instruction for the teaching of the lesson. This step employs the Gradual Release of Responsibility model to support student's development of the lesson's learning objective(s). Teaching strategies and tips for Guided and Independent Practice help teachers guide students in applying and synthesizing their new knowledge. **Guided Practice** offers students an opportunity to practice their newly-learned skills with teacher support and to collaborate with other students.

Learning Process *(continued)*

Develop Concepts

Activity Understanding Multiplication Models

■ This activity will model one-digit by two-digit multiplication in a couple of ways. Allow students to work in pairs

■ Walk the s
using an area

30
4 | 120

■ Have stud
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area model r

■ Next, introduce the concept of place value in relation to the product of 4 and 37.

37 = 3 tens + 7 ones
4 × 37 = (4 × 3 tens) + (4 × 7 ones)
4 × 3 tens: 4 × 7 ones:

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1 1 1 1 1 1 1

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LESSON 4-2 Use Place-Value Models

MENTAL MATH
Find the value of each product.

2 × 5 tens 10 tens or 100
4 × 6 ones 24 ones or 24
7 × 2 tens 14 tens or 140
6 × 3 tens 18 tens or 180

LESSON 4-2 Use Place-Value Models

Objective
• Use place-value models to illustrate and explain multiplication calculations.

Math Word
multiplication expression

For the school field day, parents bring cases of water bottles. Each case has 24 water bottles. How many water bottles are in 5 cases?

To find how many water bottles are in 5 cases, you need to find 5 × 24.

• Model the multiplication expression 5 × 24.

Think
24 = 2 tens 4 ones.
5 × 24 is 5 groups of 24.

5 × 2 tens is 10 tens.
5 × 4 ones is 20 ones.

• Regroup the 20 ones as 2 tens.

Use the Student Pages

■ In this lesson, students combine their knowledge of one-digit multiplication with the use of base ten models to find products of one- and two-digit factors.

■ Review any of the basic components of the lesson that you may find necessary: multiplication of one-digit numbers, products similar to those found in the Mental Math exercise, and modeling two- and three-digit numbers with base ten models.

■ Next, review regrouping. Show students a model with 3 rows, each containing 7 ones. *Can you regroup any of the ones as tens?* (Yes, you can regroup 20 of them as 2 tens.) Show them the model regrouped as 2 tens and 1 one.

■ Show students a model with 4 rows, each containing 3 tens. *How many tens are shown?* (12) *Can you regroup any of the tens as hundreds?* (Yes, you can regroup 10 of them as 1 hundred.) Show students the model regrouped as 1 hundred and 2 tens.

■ Now go over the example in the lesson. *How do you model 24?* (with 2 tens and 4 ones) *How can you model 5 groups of 24?* (with 5 rows, each modeling 24) Explain that this model is the product, or the result of multiplying 5 and 24, but that regrouping is needed to simplify the expression of the result. *Can you regroup any of the ones as tens?* (Yes, you can regroup 20 of them as 2 tens.) *Can you regroup any of the tens as hundreds?* (Yes, you can regroup 10 of them as 1 hundred.) After this regrouping, the result, or the product, can be clearly seen as 120.

■ Go through the same procedure to model 3 × 35.

70 ▪ LESSON 4-2

PRACTICE

Use the place-value model to find the product.

3. 5 × 14 70
4. 5 × 15 75
5. 6 × 13 78
6. 7 × 13 91
7. 8 × 12 96
8. 7 × 22 154

Draw a place-value model and complete the equation. See back of book.

9. 2 × 15 = ?
10. 3 × 24 = ?
11. 4 × 33 = ?

Problem Solving

12. George is putting boxes of books on a shelf. Each box weighs 35 pounds. The shelf will hold 100 pounds. Can George put 3 boxes of books on the shelf? Explain your answer using a place-value model. See back of book.

13. Without solving, is 6 × 25 greater than or less than 100? Use the place-value model to explain.

See back of book.

Write About It

14. How many hundreds and tens are in a place-value model for 5 × 38 after regrouping? Explain. See back of book.

LESSON 4-2 ▪ 71

PRACTICE SUMMARY (pp. 70–71)

Item	MP	DOK	Item	MP	DOK
1–8	4	1	12	1	2
9	7	2	13	2	2
10 ✓	7	2	14	6	2
11	7	2			

✓Indicates an Exit Ticket exercise for basic proficiency.

GUIDED PRACTICE

Exercise 2 requires a single regrouping of tens as a hundred.

Exercise 9 Students will need to draw the model and do the regrouping. This requires regrouping ones and not tens.

INDEPENDENT PRACTICE

Exercise 10 requires regrouping ones and not tens.

Exercise 11 requires regrouping both ones and tens.

Problem Solving

Exercise 12 Students are required to determine which numbers are the factors of the product they will be modeling, as the problem involves 3 numbers. *How is Exercise 12 different from the examples you have seen so far? Can you tell which numbers are the factors of the product you are modeling?*

Write About It

Exercise 14 Suggest to students that they use base ten blocks, or even pencil and paper, to help visualize the regrouping that must take place in this problem before writing their response.

Summarize

■ *How do you use base ten models to represent multiplication?* (Model one of the factors with base ten blocks. Then use the other factor to see how many times to repeat the model. Regroup to simplify the result.)

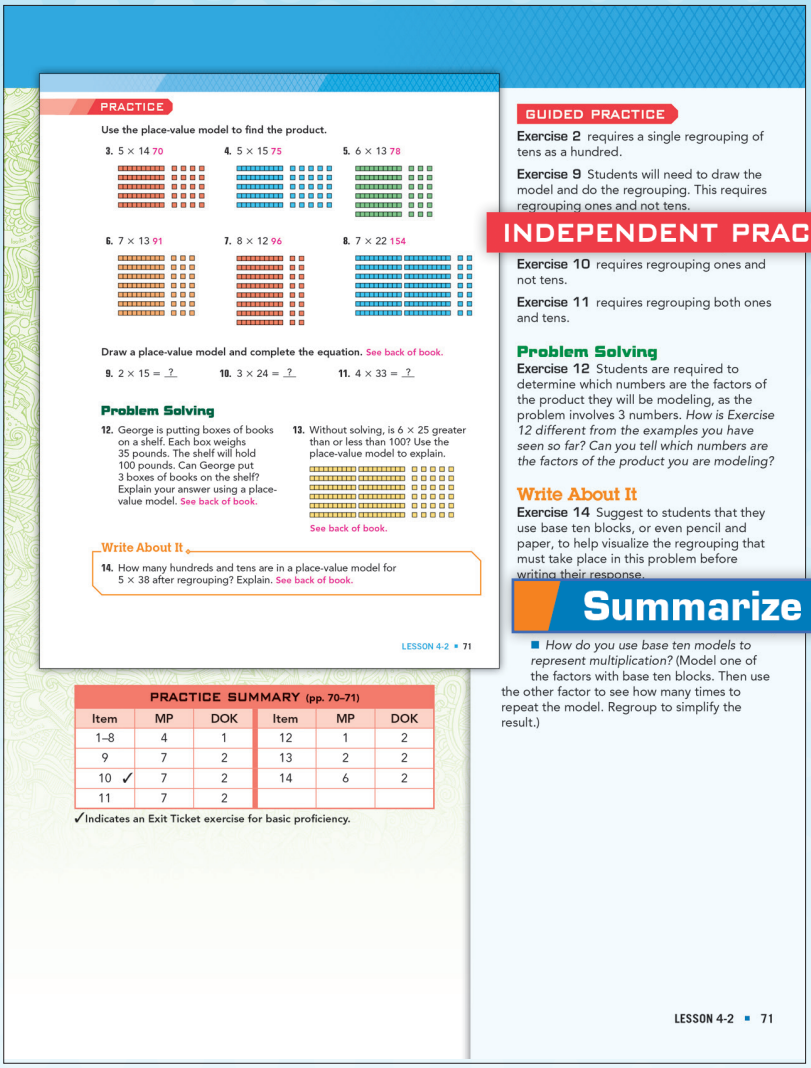
LESSON 4-2 ▪ 71

Teacher's Edition, Grade 4

Learning Process *(continued)*

NMAP Findings & Recommendations	How Addressed in *Sadlier Math*
(continued) To prepare students for Algebra, the curriculum must simultaneously develop conceptual understanding, computational fluency, and problem-solving skills. (p. xix) Use should be made of what is clearly known from rigorous research about how children learn, especially by recognizing the mutually reinforcing benefits of conceptual understanding, procedural fluency, and automatic (i.e., quick and effortless) recall of facts. (p. xiv)	*(continued)* The **Independent Practice** section provides intentionally sequenced and scaffolded exercises so that students build knowledge to reach the expectation of the learning objective. Application problems require students to apply the four-step problem-solving model (Read-Plan-Solve-Check) to efficiently and accurately solve problems. **Exit Ticket** (✓) allows you to efficiently assess students' basic understanding of each lesson's objective(s). **Mental Math**, daily fluency practice, is identified at point of use in each lesson of the Teacher's Edition and is available online at www.SadlierConnect.com. Step 3, **Summarize**, provides closure activities that act as a lesson wrap-up to check students' understanding of the lessons' skills and concepts and help inform subsequent instruction. Each lesson provides **More Practice, Homework**, and **Differentiated Activities** to support lesson development and ensure all students achieve the lesson's learning objectives. All exercises are correlated to the Standards for Mathematical Practice (MP) and Webb's Depth of Knowledge (DOK) levels to help easily identify students' levels of proficiency. Instructional strategies are provided to modify each lesson in response to student differences in readiness and learning needs. **Problem Solving** lessons in each Chapter provide students with rich opportunities to use various strategies and to apply math to cognitively demanding problems.

Learning Process *(continued)*



PRACTICE

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LESSON 4-2 ▪ 71

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Summarize

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LESSON 4-2 ▪ 71

English Language Learners (ELL)

Learners will benefit from focusing on using a model.

Read Exercise 13 on page 71

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Struggling Learners

A multiplication model is shown below.

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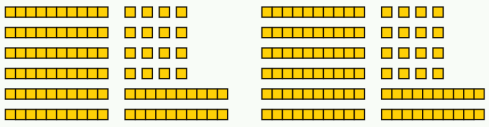
Early Finishers

Display the following multiplication model, and ask students to write a multiplication expression the model represents, determine the product, and explain how they used regrouping to find the product.



Answer: 2 × 96 = 192

Since each of the 2 groups contained 16 ones, I regrouped 10 of those ones into 1 ten, making each group have 9 tens and 6 ones. 2 times 9 tens is 180, 2 times 6 ones is 12, and 180 + 12 = 192.

MORE PRACTICE SUMMARY (WB p. 51)

Item	MP	DOK
1–3	4	2

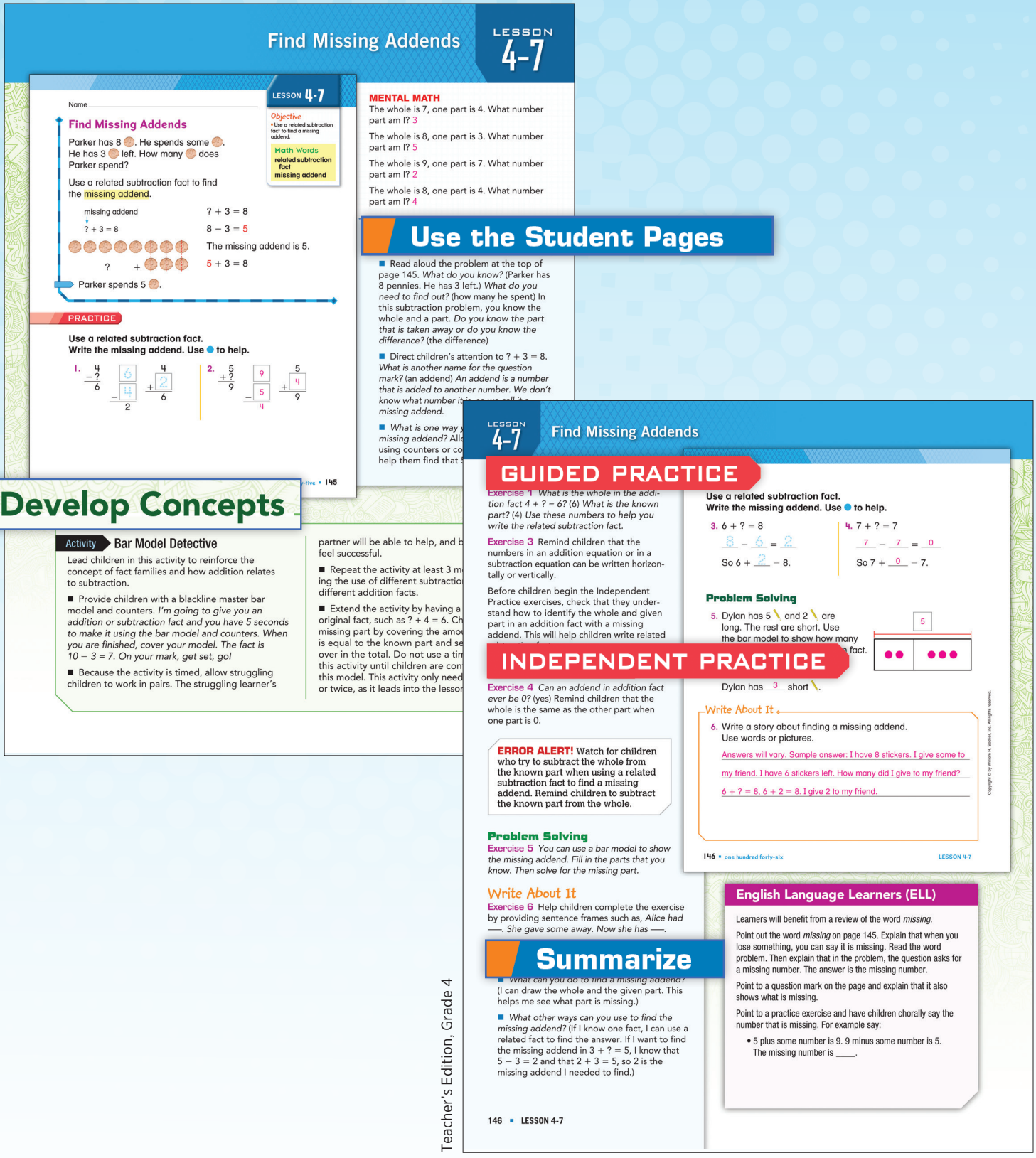
HOMEWORK SUMMARY (WB p. 52)

Item	MP	DOK
1–3	7	2
4	1	2
5	2	2
6	6	3

Instructional Practice

NMAP Findings & Recommendations	How Addressed in *Sadlier Math*
High-quality research does not support the contention that instruction should be either entirely "student-centered" or "teacher-directed." Research indicates that some forms of particular instructional practices can have a positive impact under specified conditions. (p. xiv) High-quality research does not support the exclusive use of either approach. (p. xxii)	*Sadlier Math* utilizes a balance approach to student-centered and teacher-directed instruction. Step 1 of teaching the lesson, **Develop Concepts**, engages students in the exploration of the skills/concepts introduced in the lesson. Step 2, **Use the Student Pages**, incorporates all three steps of the Gradual Release of Responsibility model (Pearson and Gallagher, 1983) beginning with direct and guided instruction (*I do it.*), guided practice (*We do it.*), peer collaboration (*You do it together.*), and concludes with independent practice (*You do it independently.*).

Instructional Practice *(continued)*

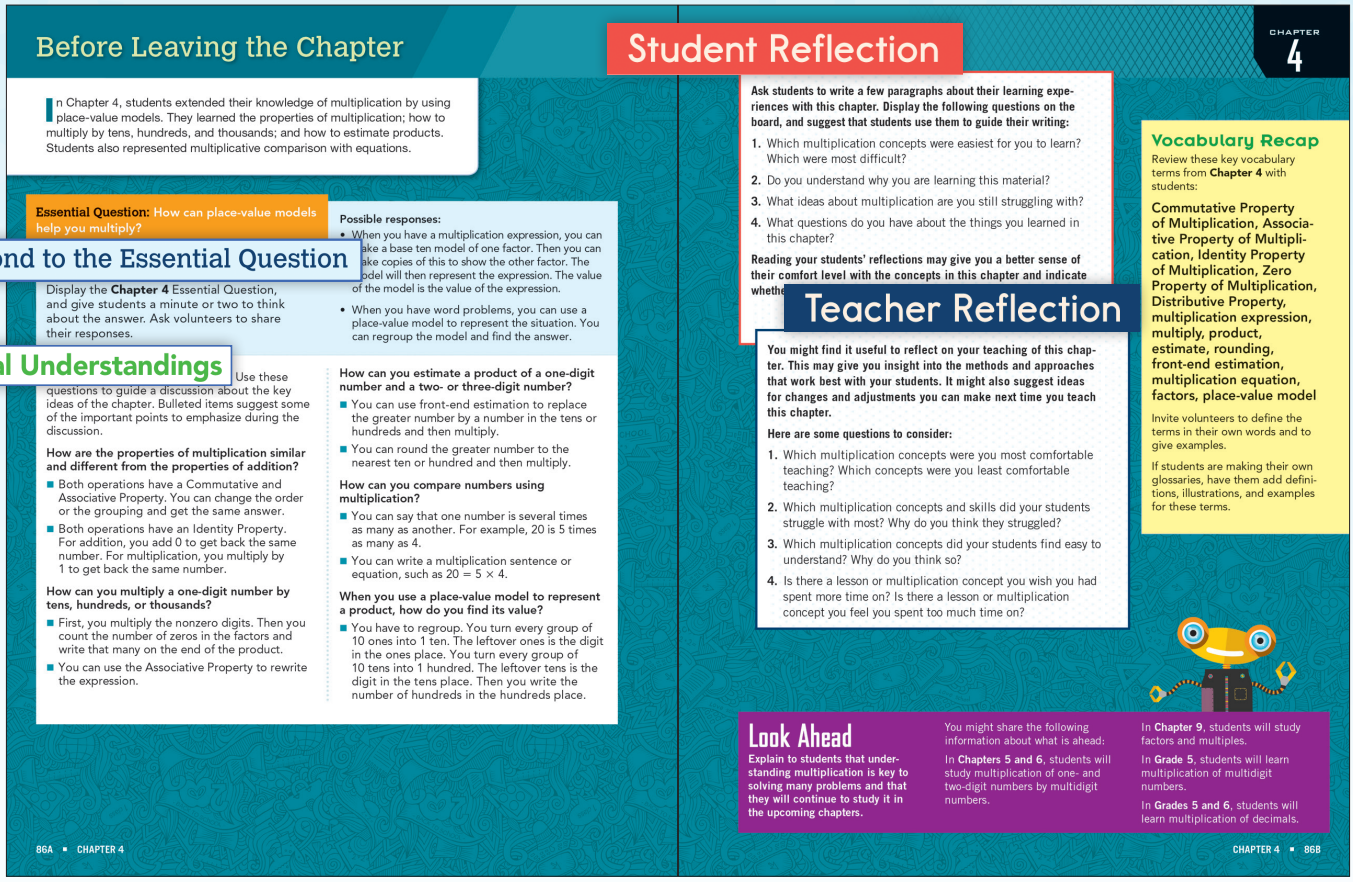


Assessment

NMAP Findings & Recommendations	How Addressed in Sadlier Math
Teachers' regular use of formative assessments improves their students' learning, especially if teachers have additional guidance on using the assessment results to design and individualize instruction. (p. 47)	*Sadlier Math*'s comprehensive diagnostic, formative, and summative assessments—in print and digital formats—help teachers monitor student progress toward mathematical proficiency, support differentiated instruction, and expose students to different item types. Varied and frequent assessments are essential for providing students with feedback to improve learning and build knowledge, keeping parents informed. Meaningful and timely feedback to students improves learning. With *Sadlier Math*'s comprehensive assessment system, teachers assess before each chapter to identify gaps and accelerate pacing when appropriate; assess during each chapter to adjust instruction, thus meeting students' immediate needs; and assess after each chapter to determine levels of concept mastery and determine the next step in the instructional process. Each chapter concludes with **Before Leaving the Chapter**, which provides guided questions at the end of the chapter to promote discussion and reflection in order to bring closure to the chapter's learning objectives. Student and Teacher Reflections allow students to become aware of their progress and teachers to consider how their teaching can improve.

Sadlier Math's Comprehensive Assessment Plan

ASSESSMENT TYPE	ASSESSMENT	WHAT IS ASSESSED	FREQUENCY	WHERE FOUND*
Diagnostic	Beginning-of-Year Test	Previous grade-level learning objectives	Once per grade level	• Student Test Booklets • Online Assessments
Diagnostic	Pre-Chapter Diagnostic Test	Chapter prerequisite skills	Once per chapter	• Online Assessments
Formative	Exit Ticket	Lesson objectives	In every lesson	• Teacher's Edition
Formative	Check Your Progress	A cluster of lesson learning objectives	One to two times per chapter	• Student Editions • Online Assessments
Formative	Chapter Reviews	Chapter learning objectives	Once per chapter	• Student Editions • Online Assessments
Summative	Performance Assessments	Integration of multiple chapter learning objectives	Once per chapter	• Student Editions • Online Assessments
Summative	Chapter Tests	Chapter learning objectives	Once per chapter	• Student Test Booklets • Online Assessments
Summative	Cumulative Tests	Cumulative learning objectives in every three chapters	Every three chapters	• Teacher's Edition of Student Test Booklets • Online Assessments
Summative	End-of-Year Test	Grade-level learning objectives	Once per grade level	• Student Test Booklets • Online Assessments



Before Leaving the Chapter

In Chapter 4, students extended their knowledge of multiplication by using place-value models. They learned the properties of multiplication; how to multiply by tens, hundreds, and thousands; and how to estimate products. Students also represented multiplicative comparison with equations.

Essential Question: How can place-value models help you multiply?

Possible responses:

- When you have a multiplication expression, you can make a base ten model of one factor. Then you can make copies of this to show the other factor. The model will then represent the expression. The value of the model is the value of the expression.
- When you have word problems, you can use a place-value model to represent the situation. You can regroup the model and find the answer.

Respond to the Essential Question

Display the **Chapter 4** Essential Question, and give students a minute or two to think about the answer. Ask volunteers to share their responses.

Critical Understandings

Use these questions to guide a discussion about the key ideas of the chapter. Bulleted items suggest some of the important points to emphasize during the discussion.

How are the properties of multiplication similar and different from the properties of addition?

- Both operations have a Commutative and Associative Property. You can change the order or the grouping and get the same answer.
- Both operations have an Identity Property. For addition, you add 0 to get back the same number. For multiplication, you multiply by 1 to get back the same number.

How can you multiply a one-digit number by tens, hundreds, or thousands?

- First, you multiply the nonzero digits. Then you count the number of zeros in the factors and write that many on the end of the product.
- You can use the Associative Property to rewrite the expression.

How can you estimate a product of a one-digit number and a two- or three-digit number?

- You can use front-end estimation to replace the greater number by a number in the tens or hundreds and then multiply.
- You can round the greater number to the nearest ten or hundred and then multiply.

How can you compare numbers using multiplication?

- You can say that one number is several times as many as another. For example, 20 is 5 times as many as 4.
- You can write a multiplication sentence or equation, such as $20 = 5 \times 4$.

When you use a place-value model to represent a product, how do you find its value?

- You have to regroup. You turn every group of 10 ones into 1 ten. The leftover ones is the digit in the ones place. You turn every group of 10 tens into 1 hundred. The leftover tens is the digit in the tens place. Then you write the number of hundreds in the hundreds place.

86A ▪ CHAPTER 4

Student Reflection

Ask students to write a few paragraphs about their learning experiences with this chapter. Display the following questions on the board, and suggest that students use them to guide their writing:

1. Which multiplication concepts were easiest for you to learn? Which were most difficult?
2. Do you understand why you are learning this material?
3. What ideas about multiplication are you still struggling with?
4. What questions do you have about the things you learned in this chapter?

Reading your students' reflections may give you a better sense of their comfort level with the concepts in this chapter and indicate whether

Teacher Reflection

You might find it useful to reflect on your teaching of this chapter. This may give you insight into the methods and approaches that work best with your students. It might also suggest ideas for changes and adjustments you can make next time you teach this chapter.

Here are some questions to consider:

1. Which multiplication concepts were you most comfortable teaching? Which concepts were you least comfortable teaching?
2. Which multiplication concepts and skills did your students struggle with most? Why do you think they struggled?
3. Which multiplication concepts did your students find easy to understand? Why do you think so?
4. Is there a lesson or multiplication concept you wish you had spent more time on? Is there a lesson or multiplication concept you feel you spent too much time on?

CHAPTER 4

Vocabulary Recap

Review these key vocabulary terms from **Chapter 4** with students:

Commutative Property of Multiplication, Associative Property of Multiplication, Identity Property of Multiplication, Zero Property of Multiplication, Distributive Property, multiplication expression, multiply, product, estimate, rounding, front-end estimation, multiplication equation, factors, place-value model

Invite volunteers to define the terms in their own words and to give examples.

If students are making their own glossaries, have them add definitions, illustrations, and examples for these terms.

Look Ahead

Explain to students that understanding multiplication is key to solving many problems and that they will continue to study it in the upcoming chapters.

You might share the following information about what is ahead:

In **Chapters 5 and 6**, students will study multiplication of one- and two-digit numbers by multidigit numbers.

In **Chapter 9**, students will study factors and multiples.

In **Grade 5**, students will learn multiplication of multidigit numbers.

In **Grades 5 and 6**, students will learn multiplication of decimals.

CHAPTER 4 ▪ 86B

Teacher's Edition, Grade 4

Shifts in Mathematics Common Core Standards

Shift	Requirement	How Addressed in *Sadlier Math*
Focus	Class time and energy spent on a deeper focus on the key concepts as prioritized by the standards.	*Sadlier Math* is designed to focus on the major work of the grade per the CCSS.
Coherence	Learning within and across grade levels is carefully connected in order to build student understanding.	The Table of Contents exemplifies a focused curriculum that includes logically sequenced lessons within a grade level and across grade levels, ensuring students become fluent in mathematics as they progress through the program. Concepts that are tightly linked together help students build new understanding of the foundations they developed in prior lessons/years. Learning Progression charts that describe how the standards are developed within and across the grade levels are provided for each Chapter in the Teacher's Editions.
Rigor as Fluency	Students are expected to have speed and accuracy with simple calculations; teachers structure class or homework time for students to memorize through repetition.	Fluency practice is provided within each lesson as Mental Math warm ups, at the end of each chapter, and online at **www.SadlierConnect.com**.
Rigor as Deep Understanding	Students deeply understand and can operate easily within a math concept before moving on.	Based on instructional best practices for concept and skill development, each lesson plan provides support for effective math instruction in three steps: • STEP 1 Develop Concepts • STEP 2 Use the Student Pages • STEP 3 Summarize

Shifts in Mathematics Common Core Standards *(continued)*

Shift	Requirement	How Addressed in *Sadlier Math*
Rigor as Application	Students use math and choose appropriate concept for application–not only when prompted.	Problem Solving lessons in each Chapter provide students with rich opportunities to use various strategies and apply math to cognitively demanding problems. A 4-step problem-solving process gives students a framework for problem solving and making sense of problems. *Source: George Polya,* How to Solve It: A New Aspect of Mathematical Method *(Princeton, NJ: Princeton University Press, 1945).* While working independently on the **Independent Practice**, **More Practice**, **Homework**, and the **Performance Assessments**, students must determine which skills, strategies, and practices best serve to solve the problems and tasks at hand.
Rigor as Dual Intensity	Students are practicing and understanding with intensity.	As students work through the scaffolded Practice, More Practice, and Homework exercises, teachers can gauge student understanding of the concepts. The **Error Alert!** provided in the Teacher's Edition guides teachers in addressing common misconceptions. Through both direct instruction and practice, students work toward a deep understanding of the concept.

References

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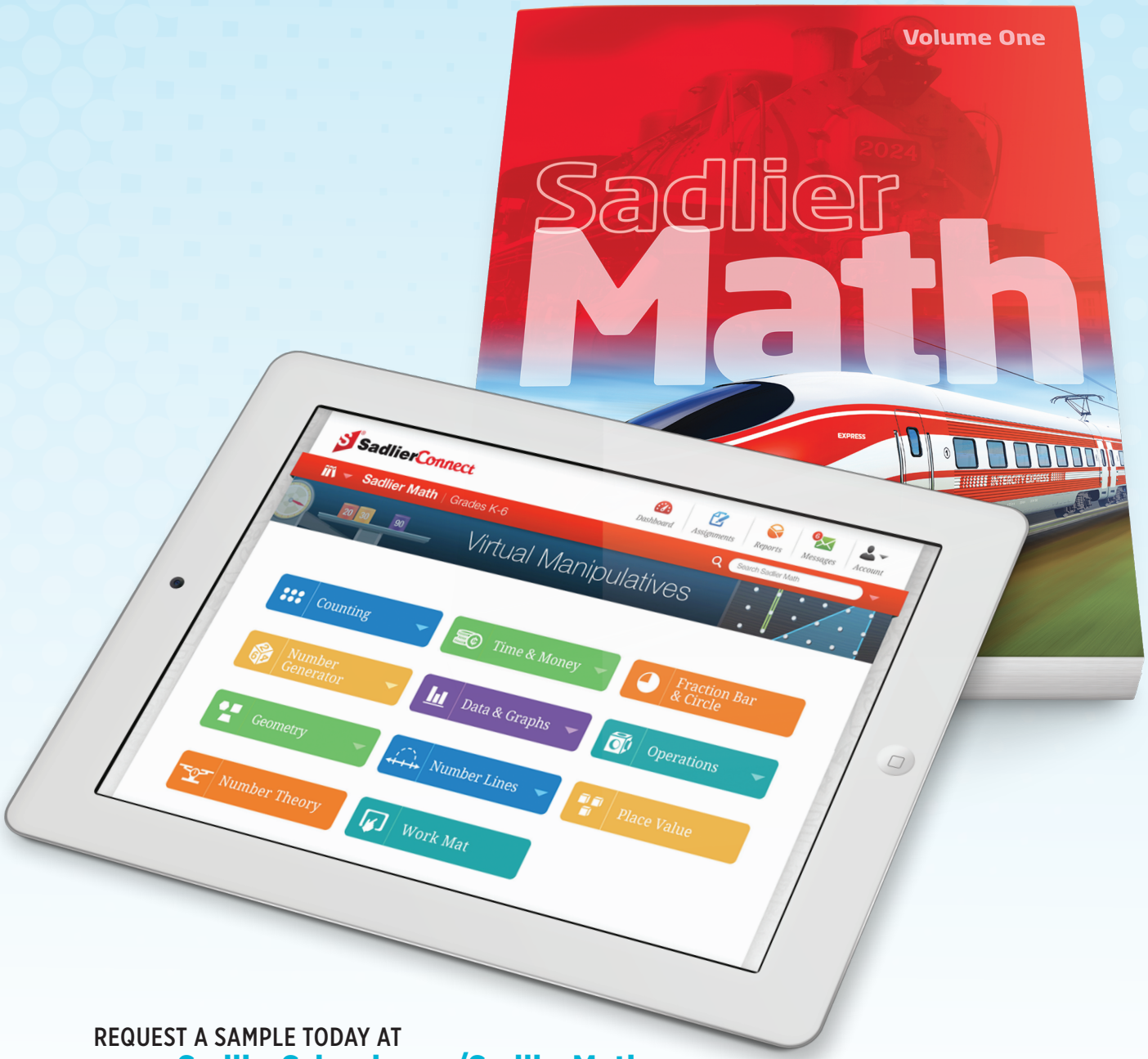
Sadlier School

Sadlier Math™ | Grades K–6

Develop Mathematically Proficient Students for Life!



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