BIG IDEAS MATH®

Modeling Real Life

Grade 4

Common Core Edition

Volume 1

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2 3 4 5 6 7 8 9 10—25 24 23 22 21

One Voice from Kindergarten Through Algebra 2

Written by renowned authors, Dr. Ron Larson and Dr. Laurie Boswell, *Big Ideas Math* offers a seamless math pedagogy from elementary through high school. Together, Ron and Laurie provide a consistent voice that encourages students to make connections through cohesive progressions and clear instruction. Since 1992, Ron and Laurie have authored over 50 mathematics programs.

Each time Laurie and I start working on a new program, we spend time putting ourselves in the position of the reader. How old is the reader? What is the reader's experience with mathematics? The answers to these questions become our writing guides. Our goal is to make the learning targets understandable and to develop these targets in a clear path that leads to student success.

Ron Larson

Ron Larson, Ph.D., is well known as lead author of a comprehensive and widely used mathematics program that ranges from elementary school through college. He holds the distinction of Professor Emeritus from Penn State Erie, The Behrend College, where he taught for nearly 40 years. He received his Ph.D. in mathematics from the University of Colorado. Dr. Larson engages in the latest research and advancements in mathematics education and consistently incorporates key pedagogical elements to ensure focus, coherence, rigor, and student self-reflection.

My passion and goal in writing is to provide an essential resource for exploring and making sense of mathematics. Our program is guided by research around the learning and teaching of mathematics in the hopes of improving the achievement of all students. May this be a successful year for you!

Laurie Boswell

Laurie Boswell, Ed.D., is the former Head of School at Riverside School in Lyndonville, Vermont. In addition to authoring textbooks, she provides mathematics consulting and embedded coaching sessions. Dr. Boswell received her Ed.D. from the University of Vermont in 2010. She is a recipient of the Presidential Award for Excellence in Mathematics Teaching and later served as president of CPAM. Laurie has taught math to students at all levels, elementary through college. In addition, Laurie has served on the NCTM Board of Directors and as a Regional Director for NCSM. Along with Ron, Laurie has co-authored numerous math programs and has become a popular national speaker.

Contributors, Reviewers, and Research

Big Ideas Learning would like to express our gratitude to the mathematics education and instruction experts who served as our advisory panel, contributing specialists, and reviewers during the writing of *Big Ideas Math: Modeling Real Life*. Their input was an invaluable asset during the development of this program.

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Research

Ron Larson and Laurie Boswell used the latest in educational research, along with the body of knowledge collected from expert mathematics instructors, to develop the *Modeling Real Life* series. The pedagogical approach used in this program follows the best practices outlined in the most prominent and widely accepted educational research, including:

- *Visible Learning*, John Hattie © 2009
- *Visible Learning for Teachers*
  John Hattie © 2012
- *Visible Learning for Mathematics*
  John Hattie © 2017
- *Principles to Actions: Ensuring Mathematical Success for All*
  NCTM © 2014
- *Adding It Up: Helping Children Learn Mathematics*
  National Research Council © 2001
- *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching*
  Jo Boaler © 2015
- *What Works in Schools: Translating Research into Action*
  Robert Marzano © 2003
- *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement*
  Marzano, Pickering, and Pollock © 2001
- *Principles and Standards for School Mathematics*
  NCTM © 2000
- *Rigorous PBL by Design: Three Shifts for Developing Confident and Competent Learners*
  Michael McDowell © 2017
- Common Core State Standards for Mathematics
  National Governors Association Center for Best Practices and Council of Chief State School Officers © 2010
- *Universal Design for Learning Guidelines*
  CAST © 2011
- Rigor/Relevance Framework®
  International Center for Leadership in Education
- *Understanding by Design*
  Grant Wiggins and Jay McTighe © 2005
- Achieve, ACT, and The College Board
- *Elementary and Middle School Mathematics: Teaching Developmentally*
  John A. Van de Walle and Karen S. Karp © 2015
- *Evaluating the Quality of Learning: The SOLO Taxonomy*
  John B. Biggs & Kevin F. Collis © 1982
- *Unlocking Formative Assessment: Practical Strategies for Enhancing Students' Learning in the Primary and Intermediate Classroom*
  Shirley Clarke, Helen Timperley, and John Hattie © 2004
- *Formative Assessment in the Secondary Classroom*
  Shirley Clarke © 2005
- *Improving Student Achievement: A Practical Guide to Assessment for Learning*
  Toni Glasson © 2009

Focus and Coherence from

Instructional Design

A single authorship team from Kindergarten through Algebra 2 results in a logical progression of focused topics with meaningful coherence from course to course.

FOCUS

A focused program dedicates lessons, activities, and assessments to grade-level standards while simultaneously supporting and engaging you in the major work of the course.

The **Learning Target** and **Success Criteria** for each lesson focus the learning into manageable chunks, using clear teaching text and Key Ideas.

Learning Target: Compare fractions that have the same denominator.

Success Criteria:

- I can model fractions that have the same denominator.
- I can use the numerators to compare fractions.
- I can explain how to compare fractions that have the same denominator.

Laurie's Notes

Preparing to Teach

In the previous lesson, students learned how to use an Inch Ruler to measure lengths to the nearest inch. In this lesson, they add *foot* and *yard* to their length measurement units. Students will measure objects to the nearest foot and nearest yard. They will also choose among an inch ruler, yardstick, and measuring tape as the instrument for measuring a specific object.

Laurie's Notes, located in the Teaching Edition, prepare your teacher for the math concepts in each chapter and lesson and make connections to the threads of major topics for the course.

Think and Grow: Find Factor Pairs

You can write whole numbers as products of two factors. The two factors are called a **factor pair** for the number.

factor pair

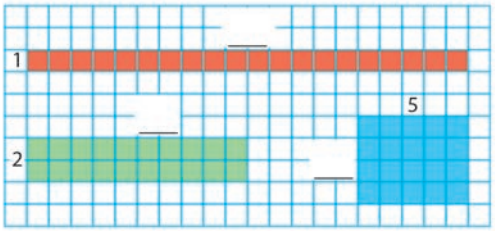
$2 \times 4 = 8$

factor factor

Example Find the factor pairs for 20.

2 and 4 are a factor pair for 8.

Find the side lengths of as many different rectangles with an area of 20 square units as possible.



A 4 × 5 rectangle has the same area as a 5 × 4 rectangle. Both give the factor pair 4 and 5.

The side lengths of each rectangle are a factor pair.

So, the factor pairs for 20 are _____ and _____, _____ and _____, and _____ and _____.

a Single Authorship Team

COHERENCE

A single authorship team built a coherent program that has intentional progression of content within each grade and between grade levels. You will build new understanding on foundations from prior grades and connect concepts throughout the course.

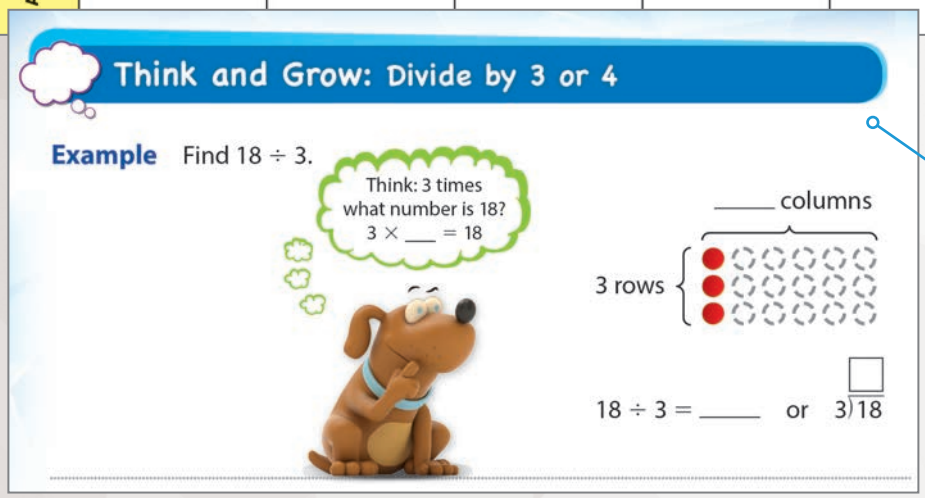
The authors developed content that progresses from prior chapters and grades to future ones. In addition to charts like this one, Laurie's Notes give your teacher insights about where you have come from and where you are going in your learning progression.

Through the Grades

Grade 4	Grade 5	Grade 6
• Create a number or shape pattern that follows a given rule. • Describe attributes of a pattern that are not part of the rule.	• Describe a coordinate system using appropriate vocabulary. • Graph points in a coordinate plane to represent real-world problems. • Explain the value of points in a coordinate plane in relation to a real-world problem. • Analyze patterns based on relationships and operations. • Create numeric patterns using given rules. • Graph ordered pairs in a coordinate plane.	• Graph ordered pairs in all four quadrants of the coordinate plane. • Draw polygons in the coordinate plane. • Graph ordered pairs in all four quadrants of the coordinate plane. • Understand ratios and describe ratio relationships.

One author team thoughtfully wrote each course, creating a seamless progression of content from Kindergarten to Algebra 2.

	Grade K	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	
Algebra and Functions	**Operations and Algebraic Thinking**				**Operations and Algebraic Thinking**		**Expressions and Equations**	
	Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from. *Chapters 5–7*	Solve problems involving addition and subtraction within 20. Apply properties of operations. Work with addition and subtraction equations. *Chapters 1–5, 10, 11*	Solve problems involving addition and subtraction within 20. Work with equal groups of objects. *Chapters 1–6, 15*	Solve problems involving multiplication and division within 100. Apply properties of multiplication. Solve problems involving the four operations, and identify and explain patterns in arithmetic. *Chapters 1–5, 8, 9, and 14*	Use the four operations with whole numbers to solve problems. Understand factors and multiples. Generate and analyze patterns. *Chapters 2–6, 12*	Write and interpret numerical expressions. Analyze patterns and relationships. *Chapters 2, 12*	Perform arithmetic with algebraic expressions. *Chapter 5* Solve one-variable equations and inequalities. *Chapters 6, 8* Analyze relationships between dependent and independent variables. *Chapter 6*	Write *Chap* Use r expre inequ *Chap*



Throughout each course, lessons build on prior learning as new concepts are introduced. Here you are reminded of a multiplication fact, that you already know, to help solve the division problem.

Rigor in Math: A Balanced Approach

Instructional Design

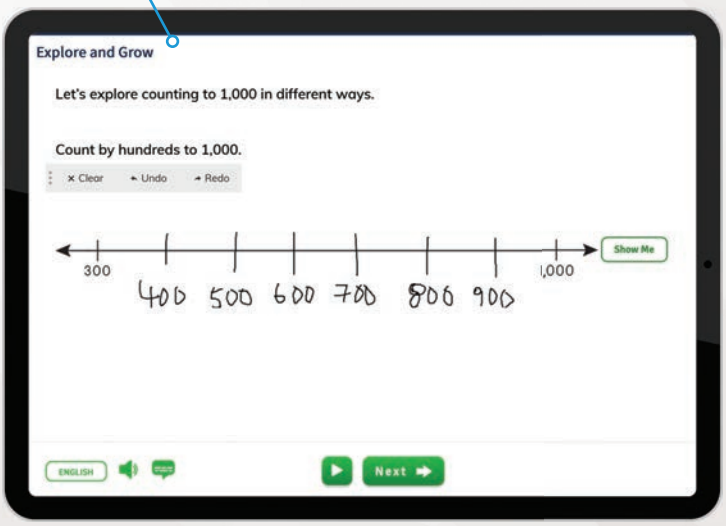
The authors wrote each chapter and every lesson to provide a meaningful balance of rigorous instruction.

RIGOR

A rigorous program provides a balance of three important building blocks.

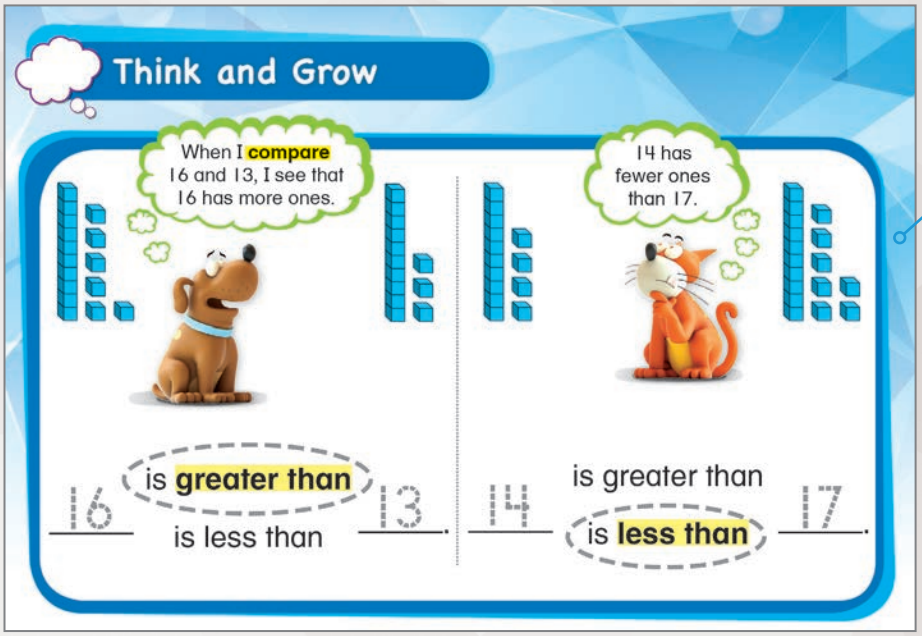
- **Conceptual Understanding**
  Discovering why
- **Procedural Fluency**
  Learning how
- **Application**
  Knowing when to apply

Conceptual Understanding
You have the opportunity to develop foundational concepts central to the *Learning Target* in each *Explore and Grow* by experimenting with new concepts, talking with peers, and asking questions.



Conceptual Thinking
Conceptual questions ask you to think deeply.

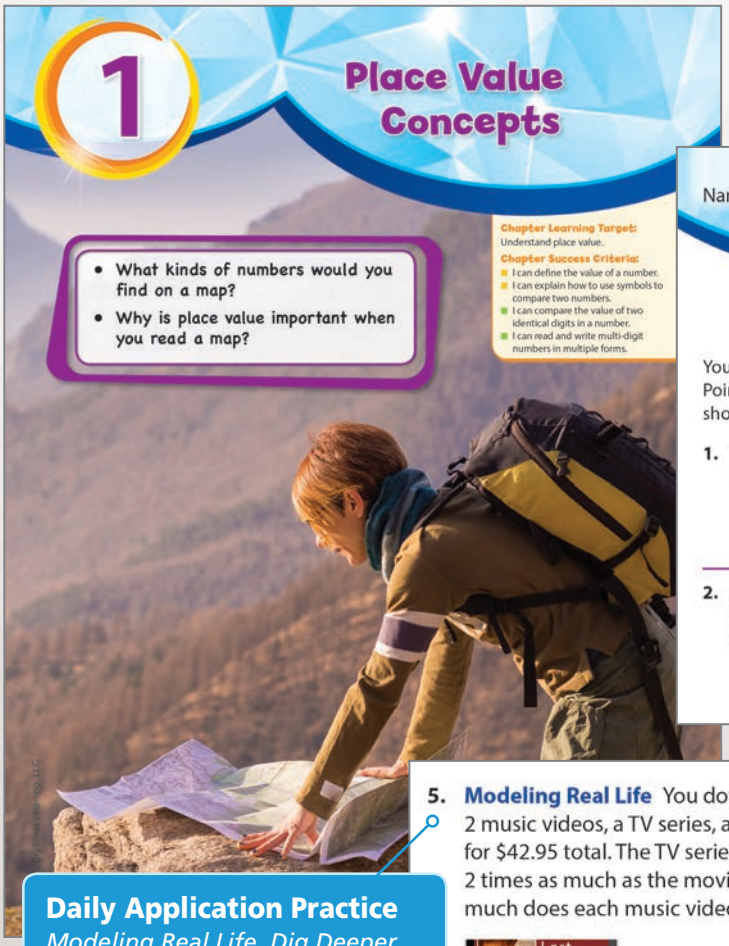
14. MP **Number Sense** A sum has 5 addends. Each addend is a unit fraction. The sum is 1. What are the addends?



Procedural Fluency
Solidify learning with clear, stepped-out teaching in *Key Ideas* and *Think and Grow* examples.

Then shift conceptual understanding into procedural fluency with *Show and Grow*, *Apply and Grow*, *Homework & Practice*, and *Review & Refresh*.

Connecting to Real Life
Begin every chapter thinking about the world around you. Then apply what you learn in the chapter with a related *Performance Task*.



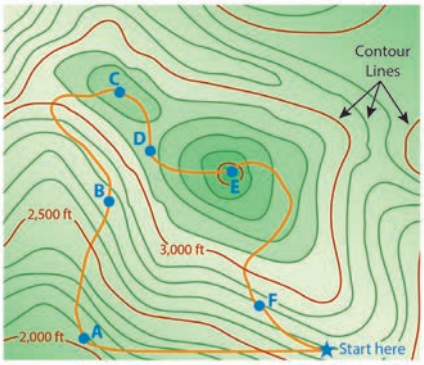
Name _____

Performance Task 1

You hike from Point A through Point F along the orange path shown on the map.

1. What is the distance in elevation between each contour line?

2. As you walk from A to C, are you walking uphill or downhill? Explain.



Daily Application Practice
Modeling Real Life, *Dig Deeper*, and other non-routine problems help you apply surface-level skills to gain a deeper understanding. These problems lead to independent problem-solving.

5. **Modeling Real Life** You download 2 music videos, a TV series, and a movie for $42.95 total. The TV series costs 2 times as much as the movie. How much does each music video cost?

6. **DIG DEEPER!** Which item costs more per ounce? How much more?

Problem-Solving Plan
Walk through the Problem-Solving Plan, featured in many *Think and Grow* examples, to help you make sense of problems with confidence.

THE PROBLEM-SOLVING PLAN

1. **Understand the Problem**
   Think about what the problem is asking, what information you know, and how you might begin to solve.
2. **Make a Plan**
   Plan your solution pathway before jumping in to solve. Identify any relationships and decide on a problem-solving strategy.
3. **Solve and Check**
   As you solve the problem, be sure to evaluate your progress and check your answers. Throughout the problem-solving process, you must continually ask, "Does this make sense?" and be willing to change course if necessary.

Embedded Mathematical Practices

Encouraging Mathematical Mindsets

Developing proficiency in the **Mathematical Practices** is about becoming a mathematical thinker. Learn to ask why, and to reason and communicate with others as you learn. Use this guide to develop proficiency with the mathematical practices.

Example A pet store receives a shipment of 8 boxes of dog treats. Each box is 2 feet high and has 18 bags of dog treats. How many ounces of dog treats does the pet store receive in the shipment?

Understand the Problem

What do you know?
- The store receives 8 boxes.
- Each box is 2 feet high.
- Each box has 18 bags of dog treats.
- Each bag weighs 32 ounces.

What do you need to find?
- You need to find how many ounces of dog treats the pet store receives in the shipment.

Make a Plan

How will you solve?
- Multiply 32 by 18 to find how many ounces of dog treats are in each box.
- Then multiply the product by 8 to find how many ounces of dog treats the pet store receives in the shipment.
- The height of each box is unnecessary information.

Solve

Step 1: How many ounces of dog treats are in each box?

$32 \times 18 = b$

b is the unknown product.

$$\begin{array}{r} \square \\ 3\ 2 \\ \times\ 1\ 8 \\ \hline \end{array}$$

$b =$ _____

Step 2: Use b to find how many ounces of dog treats the pet store receives.

$b \times 8 = p$

p is the unknown product.

$$\begin{array}{r} \square \\ \times\quad 8 \\ \hline \end{array}$$

$p =$ _____

1

One way to **Make Sense of Problems and Persevere in Solving Them** is to use the Problem-Solving Plan. Take time to analyze the given information and what the problem is asking to help you plan a solution pathway.

Look for labels such as:
- Find Entry Points
- Analyze a Problem
- Interpret a Solution
- Make a Plan
- Use a Similar Problem
- Check Your Work

2

Reason Abstractly when you explore an example using numbers and models to represent the problem. Other times, **Reason Quantitatively** when you see relationships in numbers or models and draw conclusions about the problem.

Look for labels such as:
- Reasoning
- Number Sense
- Use Equations
- Use Expressions

Example You pick $2\frac{3}{4}$ pounds of cherries. Your friend picks $1\frac{2}{4}$ pounds of cherries. How many pounds of cherries do you and your friend pick in all?

MP **Reasoning**
How do you know your answer is greater than 3 pounds without solving?

3

When you **Construct Viable Arguments and Critique the Reasoning of Others**, you make and justify conclusions and decide whether others' arguments are correct or flawed.

Look for labels such as:

- Construct an Argument
- You Be the Teacher
- Logic
- Make a Conjecture
- Justify a Result
- Compare Arguments

Find an equivalent fraction.

14. $\frac{3}{12}$

MP Construct an Argument
Why should you use a common factor other than 1 when finding an equivalent fraction?

17. **MP Logic** Is ★ greater than or less than ▼? Explain.

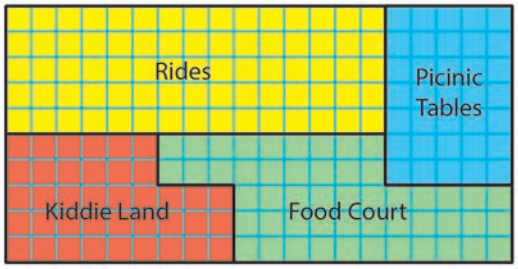
4

To **Model with Mathematics**, apply the math you learned to a real-life problem and interpret mathematical results in the context of the situation.

Look for labels such as:

- Modeling Real Life
- Graph Data
- Analyze a Relationship
- Does It Make Sense?

Modeling Real Life Use the amusement park map to answer the question.



9. What is the area of the food court section?

10. **DIG DEEPER!** Which area is greater, the kiddie land section or the picnic tables section? Explain.

BUILDING TO FULL UNDERSTANDING

Throughout each course, you have opportunities to demonstrate specific aspects of the mathematical practices. Labels throughout the book indicate gateways to those aspects. Collectively, these opportunities will lead to a full understanding of each mathematical practice. Developing these mindsets and habits will give meaning to the mathematics you learn.

Embedded Mathematical Practices (continued)

5

To **Use Appropriate Tools Strategically**, you need to know what tools are available and think about how each tool might help you solve a mathematical problem. When you choose a tool to use, remember that it may have limitations.

Look for labels such as:
- Choose Tools
- Use Math Tools
- Use Technology

10. MP **Choose Tools** Choose the best tool to measure each item.

A B C D

The liquid volume of a bowl: _____

The length of a spoon: _____

The mass of an orange: _____

The number of minutes you jog: _____

Explore and Grow

Work with a partner. Use an appropriate tool to mark 3 lengths on the floor or in a hallway that are 1 yard, 2 yards, and 3 yards long. Then measure the lengths in feet and in inches.

Think: How do the lengths, in inches, compare to the lengths in feet? How does each length compare to 1 yard?

MP **Choose Tools**
How did you decide which tool to use to draw the 2-yard and 3-yard lengths?

1 foot is _____ times as long as 1 inch.

1 yard is _____ times as long as 1 foot.

1 yard is _____ times as long as 1 inch.

6

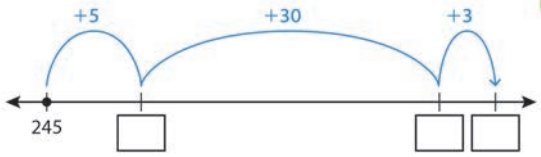
When you **Attend to Precision**, you are developing a habit of being careful in how you talk about concepts, label work, and write answers.

Look for labels such as:
- Precision
- Communicate Clearly
- Maintain Accuracy

13. MP **Precision** How many decimal places are in the unknown factor? Explain.

_____ × 2.8 = 4.48

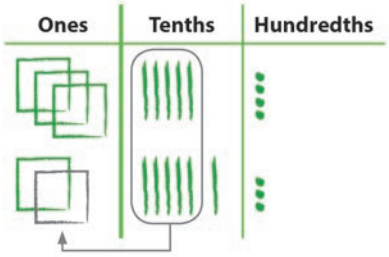
Another Way: Use the *make a ten* strategy. Start at 245. Count on to the nearest ten. Then count on by tens and by ones.



245 + 38 = _____

MP **Maintain Accuracy**
After you add 3, how do you keep track of how much more you need to add?

8. **Structure** Write an equation represented by the quick sketch.



Example

Thousands Period			Ones Period		
Hundreds	Tens	Ones	Hundreds	Tens	Ones
2	7	5,	4	4	9

- The number, in standard form, is _____.
- The value of the digit 7 is 7 ten thousands, or _____.
- The value of the digit 4 in the hundreds place is _____.
- The value of the digit 4 in the tens place is _____.
- The value of the digit 4 in the hundreds place is _____ times the value of the digit 4 in the tens place.

7

Look For and Make Use of Structure by looking closely to see structure within a mathematical statement, or stepping back for an overview to see how individual parts make one single object.

Look for labels such as:
- Structure
- Patterns

Repeated Reasoning Explain to your partner how you can use expanded form to find 364 × 8.

Example Create a shape pattern by repeating the rule "triangle, hexagon, square, rhombus." What is the 42nd shape in the pattern?

Create the pattern.

42 ÷ 4 is 10 R2, so when the pattern repeats 10 times,

the 40th shape is a _____. So, the 41st shape is a

_____ and the 42nd shape is a _____.

Example Describe the dot re

dots, so it has 1 × _____ = _____ dots.

8

When you **Look For and Express Regularity in Repeated Reasoning**, you can notice patterns and make generalizations. Remember to keep in mind the goal of a problem, which will help you evaluate reasonableness of answers along the way.

Look for labels such as:
- Repeated Reasoning
- Find a Rule

Visible Learning Through Learning Targets,

Making Learning Visible

Knowing the learning intention of a chapter or lesson helps you focus on the purpose of an activity, rather than simply completing it in isolation. This program supports visible learning through the consistent use of Learning Targets and Success Criteria to help you become successful.

Every chapter and lesson shows a **Learning Target** and related **Success Criteria**. These are purposefully integrated into each carefully written lesson.

Name _____

Measure Elapsed Time within the Hour 12.2

Learning Target: Measure elapsed time, in minutes, within the same hour.

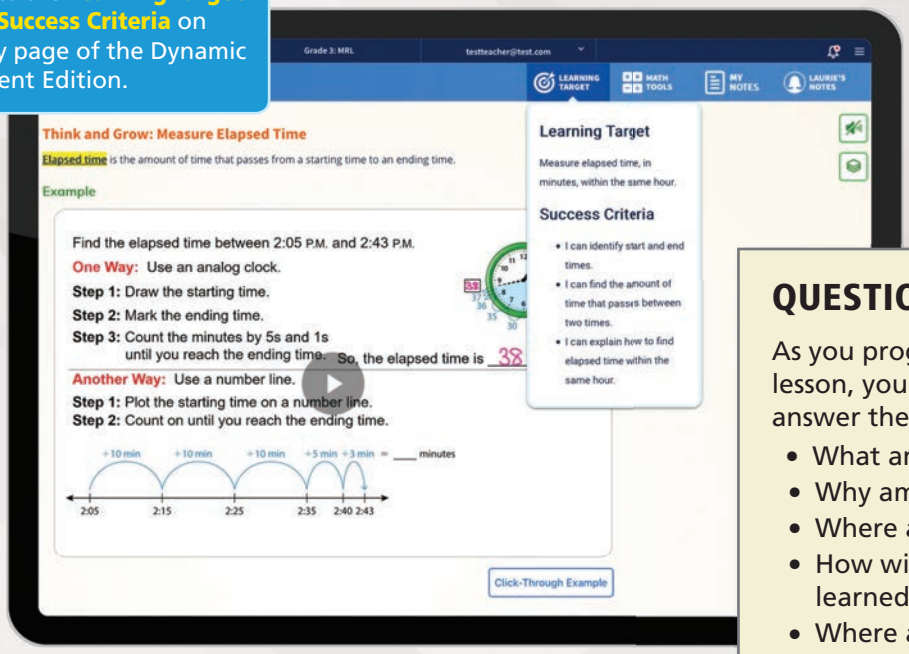
Success Criteria:
- I can identify start and end times.
- I can find the amount of time that passes between two times.
- I can explain how to find elapsed time within the same hour.

Chapter Learning Target:
Understand data.

Chapter Success Criteria:
- Identify a tool to collect data.
- Create a tally chart to make a graph.
- Represent data in different ways.
- Interpret data in different ways.

There are four **Success Criteria** in each chapter.
- indicates surface level
- indicates deeper level which leads to the transfer of learning

Access the **Learning Target** and **Success Criteria** on every page of the Dynamic Student Edition.



QUESTIONS FOR LEARNING

As you progress through a lesson, you should be able to answer the following questions.

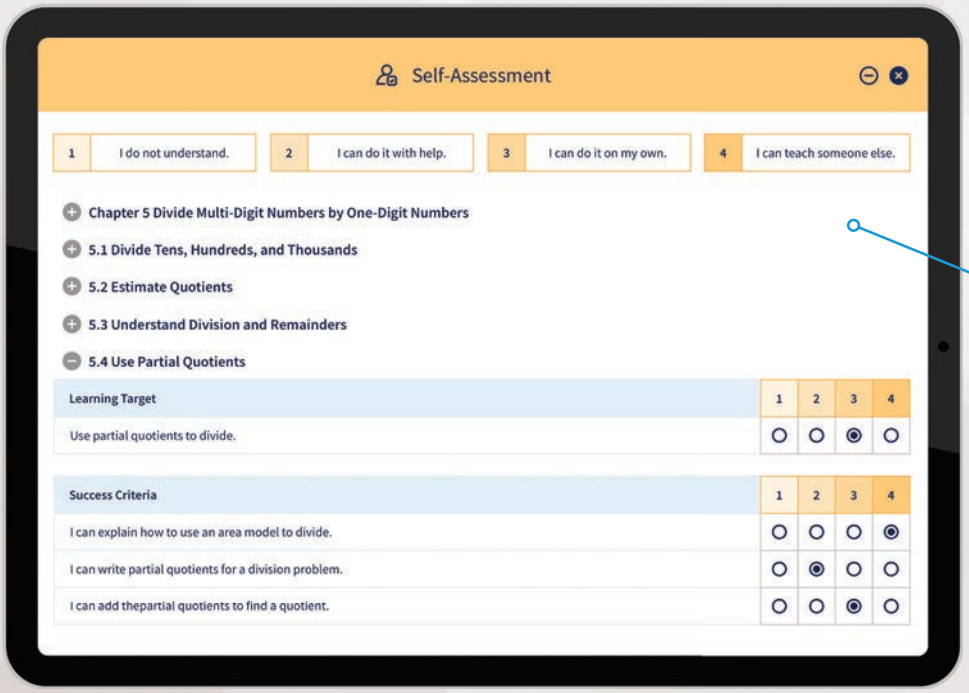
- What am I learning?
- Why am I learning this?
- Where am I in my learning?
- How will I know when I have learned it?
- Where am I going next?

Success Criteria, and Self-Assessment

1	2	3	4
I do not understand.	I can do it with help.	I can do it on my own.	I can teach someone else.

Use a 4-point scale to rate your understanding of each success criterion. Keep track of your learning on paper or online.

3.8 Multiply Three Factors				
Learning Target: Use the Associative property of Multiplication.	1	2	3	4
I can explain the Associative Property of Multiplication.	1	2	3	4
I can change the grouping of factors.	1	2	3	4
I can multiply three factors to find a product.	1	2	3	4



Self-Assessments are included throughout every lesson, and in the **Chapter Review**, to help you take ownership of your learning and think about where to go next.

Ensuring Positive Outcomes

John Hattie's *Visible Learning* research consistently shows that using Learning Targets and Success Criteria can result in two years' growth in one year, ensuring positive outcomes for your learning and achievement.

Sophie Murphy, M.Ed., wrote the chapter-level Learning Targets and Success Criteria for this program. Sophie is currently completing her Ph.D. at the University of Melbourne in Australia with Professor John Hattie as her leading supervisor. Sophie completed her Master's thesis with Professor John Hattie in 2015. Sophie has over 20 years of experience as a teacher and school leader in private and public school settings in Australia.

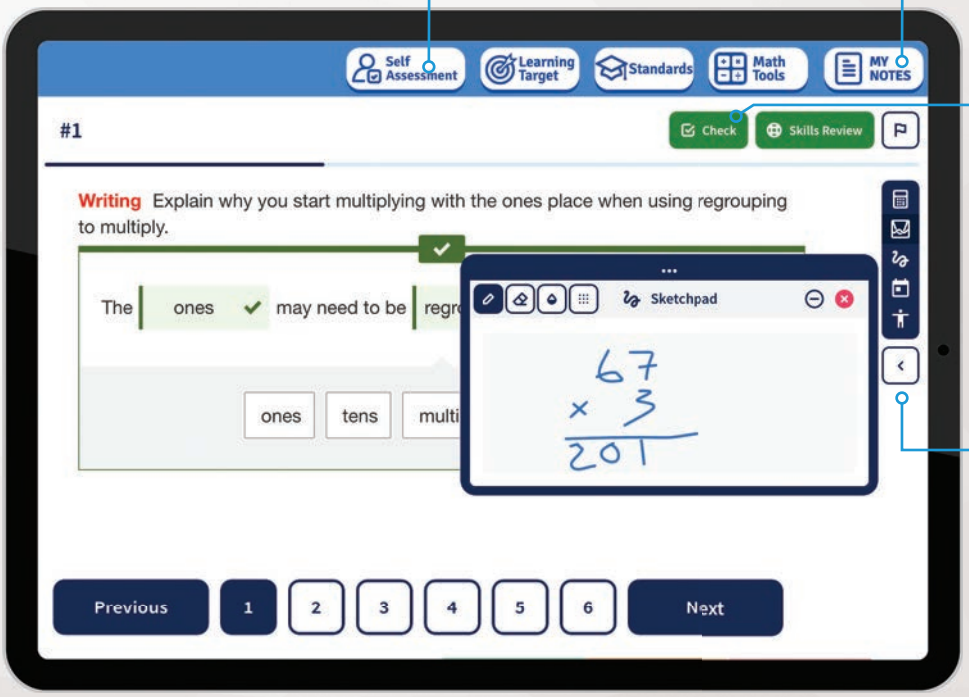
Strategic Support for Online Learning

Get the Support You Need, When You Need It

There will be times throughout this course when you may need help. Whether you missed a lesson, did not understand the content, or just want to review, take advantage of the resources provided in the *Dynamic Student Edition*.

Use the **Self-Assessment** tool to keep track of your understanding of the lesson's Learning Target and Success Criteria.

Take notes throughout the lesson using the **My Notes** function. These notes will be organized by chapter and lesson.



Check your answers to selected exercises as you work through the lesson. Use the **Help** option to view the Digital Example and Tutorial Extra Example videos.

Use the available **tools**, such as the calculator or sketchpad, to help clearly show your work and emphasize your math knowledge. Tools are easy to use and were created with accessibility and functionality in mind.

USE THESE QR CODES TO EXPLORE ADDITIONAL RESOURCES

Multi-Language Glossary
View definitions and examples of vocabulary words

Skills Trainer
Practice previously learned skills

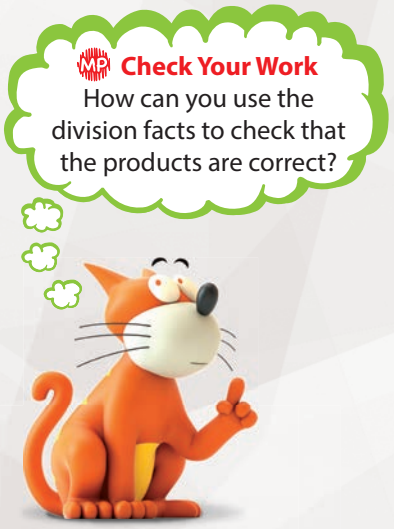
Interactive Tools
Visualize mathematical concepts

Skills Review Handbook
A collection of review topics

Learning with Newton and Descartes

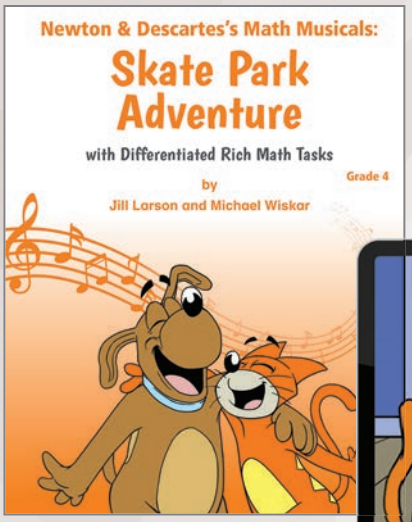
Who are Newton and Descartes?

Newton and Descartes are helpful math assistants who appear throughout your math book! They encourage you to think deeply about concepts and develop strong mathematical mindsets with *Mathematical Practice* questions.

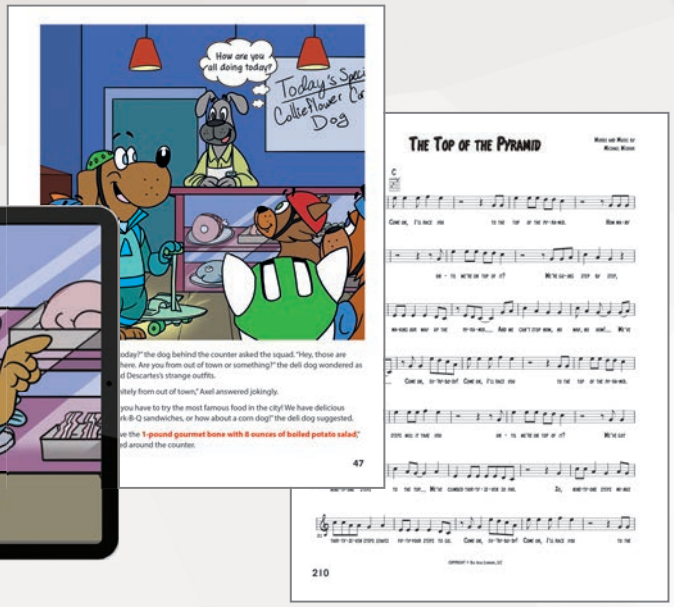


Newton & Descartes's Math Musicals

Math Musicals offer an engaging connection between math, literature, and music! Newton and Descartes team up in these educational stories and songs to bring mathematics to life!



Math Musicals animation and story



Sheet Music

1 Place Value Concepts

Vocabulary 2
1.1 Understand Place Value 3
1.2 Read and Write Multi-Digit Numbers 9
1.3 Compare Multi-Digit Numbers 15
1.4 Round Multi-Digit Numbers 21
Performance Task: Elevation Maps 27
Game: Place Value Plug In 28
Chapter Practice 29

2 Add and Subtract Multi-Digit Numbers

Vocabulary 32
2.1 Estimate Sums and Differences 33
2.2 Add Multi-Digit Numbers 39
2.3 Subtract Multi-Digit Numbers 45
2.4 Use Strategies to Add and Subtract 51
2.5 Problem Solving: Addition and Subtraction 57
Performance Task: Population 63
Game: Race to the Moon 64
Chapter Practice 65

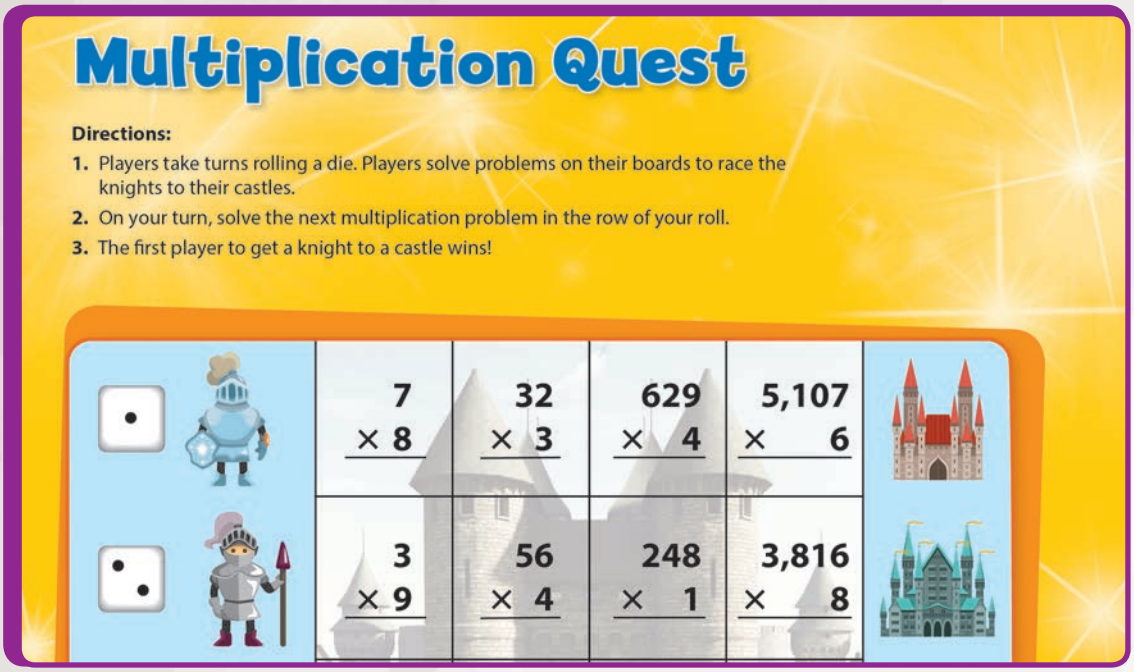
- Major Topic
- Supporting Topic
- Additional Topic

3 Multiply by One-Digit Numbers

Vocabulary 68

- 3.1 Understand Multiplicative Comparisons 69
- 3.2 Multiply Tens, Hundreds, and Thousands 75
- 3.3 Estimate Products by Rounding 81
- 3.4 Use the Distributive Property to Multiply 87
- 3.5 Use Expanded Form to Multiply 93
- 3.6 Use Partial Products to Multiply 99
- 3.7 Multiply Two-Digit Numbers by One-Digit Numbers 105
- 3.8 Multiply Three- and Four-Digit Numbers by One-Digit Numbers 111
- 3.9 Use Properties to Multiply 117
- 3.10 Problem Solving: Multiplication 123

Performance Task: Sound Waves 129
Game: Multiplication Quest 130
Chapter Practice 131
Cumulative Practice 135
STEAM Performance Task: Bridge 139



4 Multiply by Two-Digit Numbers

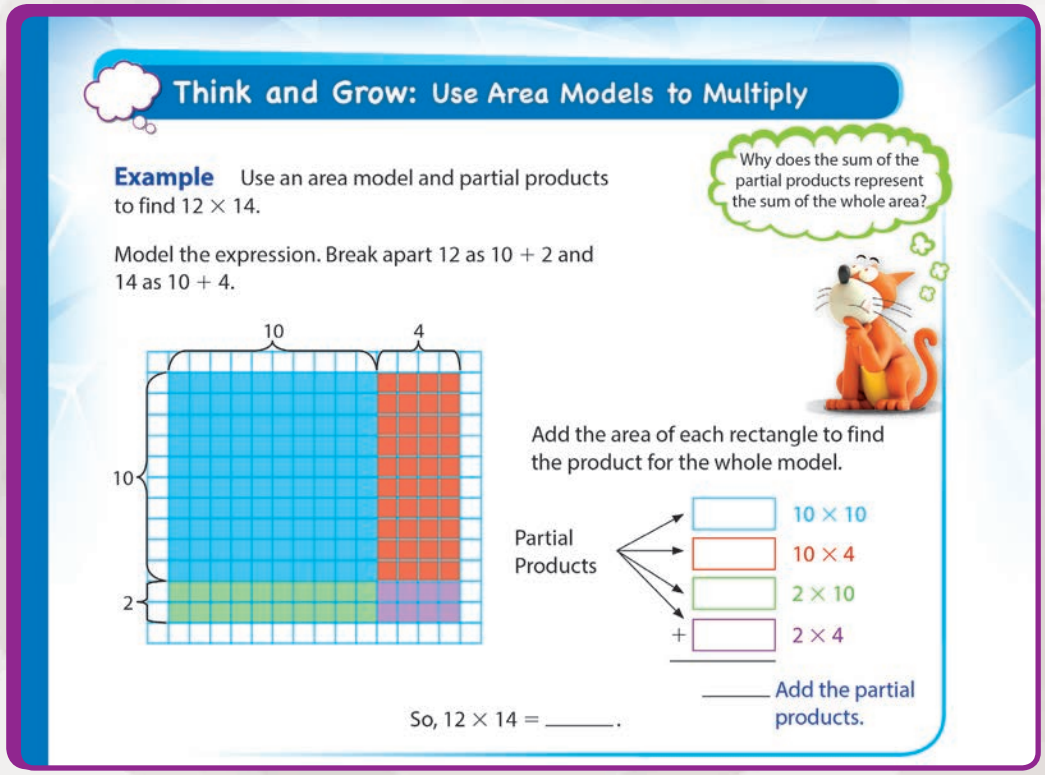
Vocabulary 142

- 4.1 Multiply by Tens 143
- 4.2 Estimate Products 149
- 4.3 Use Area Models to Multiply Two-Digit Numbers 155
- 4.4 Use the Distributive Property to Multiply Two-Digit Numbers 161
- 4.5 Use Partial Products to Multiply Two-Digit Numbers 167
- 4.6 Multiply Two-Digit Numbers 173
- 4.7 Practice Multiplication Strategies 179
- 4.8 Problem Solving: Multiplication with Two-Digit Numbers 185

Performance Task: Wind Turbines 191

Game: Multiplication Boss 192

Chapter Practice 193



Think and Grow: Use Area Models to Multiply

Example Use an area model and partial products to find 12 × 14.

Why does the sum of the partial products represent the sum of the whole area?

Model the expression. Break apart 12 as 10 + 2 and 14 as 10 + 4.

10 4

10

2

Add the area of each rectangle to find the product for the whole model.

Partial Products

10 × 10

10 × 4

2 × 10

\+ 2 × 4

_____ Add the partial products.

So, 12 × 14 = _____.

Divide Multi-Digit Numbers by One-Digit Numbers

Vocabulary 198

- 5.1 Divide Tens, Hundreds, and Thousands 199
- 5.2 Estimate Quotients 205
- 5.3 Understand Division and Remainders 211
- 5.4 Use Partial Quotients 217
- 5.5 Use Partial Quotients with a Remainder 223
- 5.6 Divide Two-Digit Numbers by One-Digit Numbers 229
- 5.7 Divide Multi-Digit Numbers by One-Digit Numbers 235
- 5.8 Divide by One-Digit Numbers 241
- 5.9 Problem Solving: Division 247

Performance Task: Planetarium 253
Game: Three in a Row: Division Dots 254
Chapter Practice 255

Factors, Multiples, and Patterns

Vocabulary 260

- 6.1 Understand Factors 261
- 6.2 Factors and Divisibility 267
- 6.3 Relate Factors and Multiples 273
- 6.4 Identify Prime and Composite Numbers 279
- 6.5 Number Patterns 285
- 6.6 Shape Patterns 291

Performance Task: Basketball 297
Game: Multiple Lineup 298
Chapter Practice 299

- Major Topic
- Supporting Topic
- Additional Topic

Understand Fraction Equivalence and Comparison

Vocabulary 304
7.1 Model Equivalent Fractions 305
7.2 Generate Equivalent Fractions by Multiplying 311
7.3 Generate Equivalent Fractions by Dividing 317
7.4 Compare Fractions Using Benchmarks 323
7.5 Compare Fractions 329
Performance Task: Designs 335
Game: Fraction Boss 336
Chapter Practice 337
Cumulative Practice 339
STEAM Performance Task: Sea Level 343

Add and Subtract Fractions

Vocabulary 346
8.1 Use Models to Add Fractions 347
8.2 Decompose Fractions 353
8.3 Add Fractions with Like Denominators 359
8.4 Use Models to Subtract Fractions 365
8.5 Subtract Fractions with Like Denominators 371
8.6 Model Fractions and Mixed Numbers 377
8.7 Add Mixed Numbers 383
8.8 Subtract Mixed Numbers 389
8.9 Problem Solving: Fractions 395
Performance Task: Music Notes 401
Game: Three in a Row: Fraction Add or Subtract 402
Chapter Practice 403

- Major Topic
- Supporting Topic
- Additional Topic

9 Multiply Whole Numbers and Fractions

Vocabulary 408

- 9.1 Understand Multiples of Unit Fractions 409
- 9.2 Understand Multiples of Fractions 415
- 9.3 Multiply Whole Numbers and Fractions 421
- 9.4 Multiply Whole Numbers and Mixed Numbers 427
- 9.5 Problem Solving: Fraction Operations 433

Performance Task: Sounds 439

Game: Three in a Row: Fraction Multiplication 440

Chapter Practice 441

10 Relate Fractions and Decimals

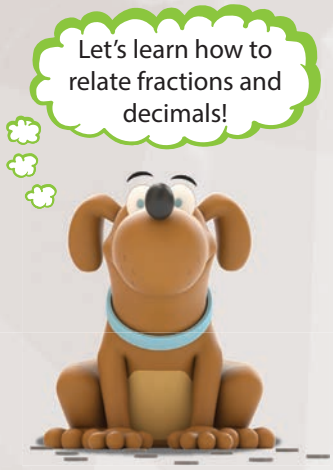
Vocabulary 444

- 10.1 Understand Tenths 445
- 10.2 Understand Hundredths 451
- 10.3 Fractions and Decimals 457
- 10.4 Compare Decimals 463
- 10.5 Add Decimal Fractions and Decimals 469
- 10.6 Fractions, Decimals, and Money 475
- 10.7 Operations with Money 481

Performance Task: Baking 487

Game: Decimal Boss 488

Chapter Practice 489



Understand Measurement Equivalence

Vocabulary 494
11.1 Length in Metric Units 495
11.2 Mass and Capacity in Metric Units 501
11.3 Length in Customary Units 507
11.4 Weight in Customary Units 513
11.5 Capacity in Customary Units 519
11.6 Make and Interpret Line Plots 525
11.7 Units of Time 531
11.8 Problem Solving: Elapsed Time 537
11.9 Mixed Measures 543
Performance Task: Racing 549
Game: Conversion Flip and Find 550
Chapter Practice 551
Cumulative Practice 555
STEAM Performance Task: Electricity 559

Use Perimeter and Area Formulas

Vocabulary 562
12.1 Perimeter Formula for a Rectangle 563
12.2 Area Formula for a Rectangle 569
12.3 Find Unknown Measures 575
12.4 Problem Solving: Perimeter and Area 581
Performance Task: Animations 587
Game: Area Roll and Conquer 588
Chapter Practice 589

- Major Topic
- Supporting Topic
- Additional Topic

13 Identify and Draw Lines and Angles

Vocabulary 592
13.1 Points, Lines and Rays 593
13.2 Identify and Draw Angles 599
13.3 Identify Parallel and Perpendicular Lines 605
13.4 Understand Degrees 611
13.5 Find Angle Measures 617
13.6 Measure and Draw Angles 623
13.7 Add Angle Measures 629
13.8 Find Unknown Angle Measures 635
Performance Task: Maps 641
Game: Geometry Dots 642
Chapter Practice 643

14 Identify Symmetry and Two-Dimensional Shapes

Vocabulary 648
14.1 Line Symmetry 649
14.2 Draw Symmetric Shapes 655
14.3 Classify Triangles by Sides 661
14.4 Classify Triangles by Angles 667
14.5 Classify Quadrilaterals 673
Performance Task: Roof Trusses 679
Game: Pyramid Climb and Slide 680
Chapter Practice 681
Cumulative Practice 683
STEAM Performance Task: Design 687

Glossary A1
Index A13
Reference Sheet A33