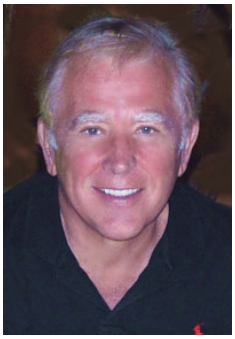
Big Ideas Math

Authors

No other authorship team in the industry provides the balance of classroom experience and mathematical expertise that the *Big Ideas Math* program authors bring to the table. Dr. Ron Larson and Dr. Laurie Boswell began writing together in 1992. Since that time, they have authored over three dozen textbooks. In their collaboration, Ron is primarily responsible for the Student Edition while Laurie is primarily responsible for the Teaching Edition.



Ron Larson, Ph.D., is well known as the lead author of a comprehensive program for mathematics that spans middle school, high school, and college courses. 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's numerous professional activities keep him actively involved in the mathematics education community and allow him to fully understand the needs of students, teachers, supervisors, and administrators.

Laurie Boswell, Ed.D., is the former Head of School at Riverside School in Lyndonville, Vermont. In addition to textbook authoring, 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 is a Tandy Technology Scholar. 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 programs and has become a popular national speaker.

- **A Research-Based Program**

  - The *Big Ideas Math* program is a research-based curriculum providing a rigorous, focused, and coherent curriculum for middle school and high school students. Ron Larson and Laurie Boswell utilized their expertise as well as the body of knowledge collected by additional expert mathematicians and researchers to develop each course.

    The pedagogical approach to this program follows the best practices outlined in the most prominent and widely-accepted educational research and standards.

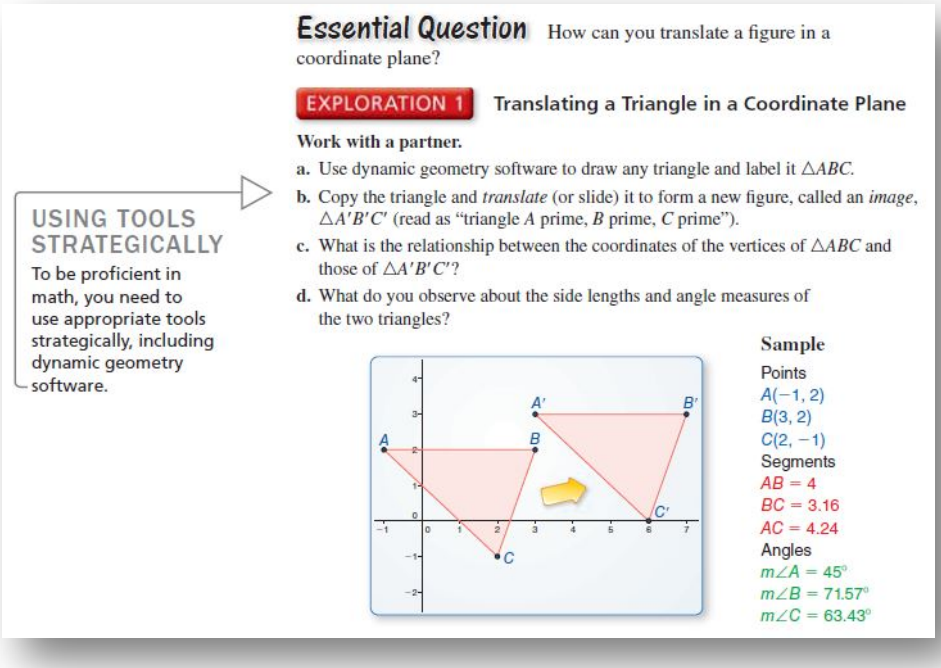
    - Achieve, ACT, and The College Board
    - Adding It Up: Helping Children Learn Mathematics
    - National Research Council ©2001

- Common Core State Standards
- National Governors Association Center for Best Practices and the Council of Chief State School Officers ©2010
- Curriculum Focal Points
- National Council of Teachers of Mathematics (NCTM) ©2006
- Principles and Standards for School Mathematics
- National Council of Teachers of Mathematics (NCTM) ©2000
- Project Based Learning
- The Buck Institute
- Rigor / Relevance Framework$_{TM}$
- International Center for Leadership in Education
- Universal Design for Learning Guidelines
- CAST ©2011

o **A Balanced Approach to Instruction**

- The *Big Ideas Math* program follows a balanced instructional approach. The program balances conceptual understanding with procedural fluency, as research shows that students benefit from equal exposure to discovery learning and teacher instruction.

Each section in the program begins with an *Exploration* that encourages conceptual understanding. These provide students with the opportunity to explore, question, explain, and persevere as they seek to answer Essential Questions that encourage abstract thought.



Essential Question How can you translate a figure in a coordinate plane?

EXPLORATION 1 **Translating a Triangle in a Coordinate Plane**

Work with a partner.

a. Use dynamic geometry software to draw any triangle and label it $\triangle ABC$.

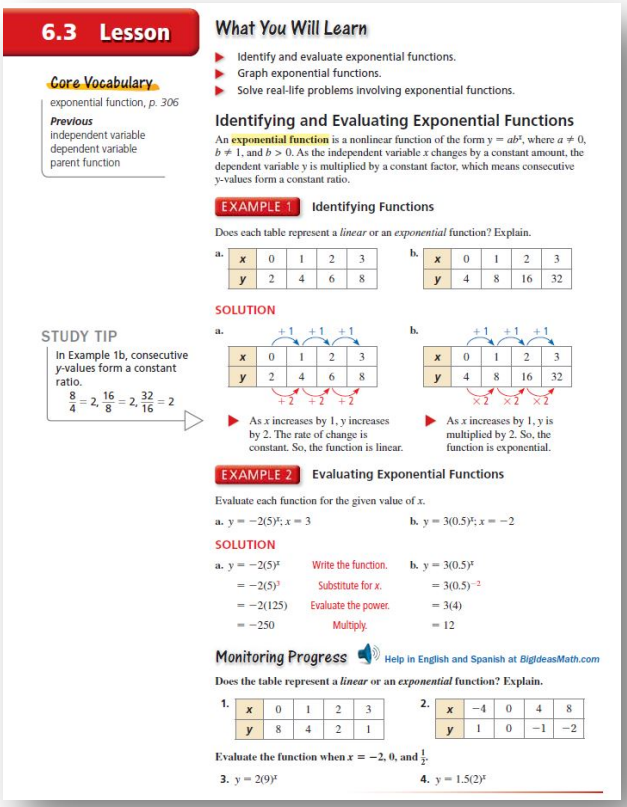
b. Copy the triangle and *translate* (or slide) it to form a new figure, called an *image*, $\triangle A'B'C'$ (read as "triangle A prime, B prime, C prime").

c. What is the relationship between the coordinates of the vertices of $\triangle ABC$ and those of $\triangle A'B'C'$?

d. What do you observe about the side lengths and angle measures of the two triangles?

USING TOOLS STRATEGICALLY
To be proficient in math, you need to use appropriate tools strategically, including dynamic geometry software.

Sample
Points
$A(-1, 2)$
$B(3, 2)$
$C(2, -1)$
Segments
$AB = 4$
$BC = 3.16$
$AC = 4.24$
Angles
$m\angle A = 45^\circ$
$m\angle B = 71.57^\circ$
$m\angle C = 63.43^\circ$



6.3 Lesson

What You Will Learn

- Identify and evaluate exponential functions.
- Graph exponential functions.
- Solve real-life problems involving exponential functions.

Core Vocabulary

exponential function, *p. 306*

Previous

independent variable
dependent variable
parent function

Identifying and Evaluating Exponential Functions

An **exponential function** is a nonlinear function of the form $y = ab^x$, where $a \neq 0$, $b \neq 1$, and $b > 0$. As the independent variable x changes by a constant amount, the dependent variable y is multiplied by a constant factor, which means consecutive y-values form a constant ratio.

EXAMPLE 1 **Identifying Functions**

Does each table represent a *linear* or an *exponential* function? Explain.

a.

x	0	1	2	3
y	2	4	6	8

b.

x	0	1	2	3
y	4	8	16	32

SOLUTION

a.

x	0	1	2	3
y	2	4	6	8

(+1, +1, +1 across the x-row; +2, +2, +2 across the y-row)

▶ As x increases by 1, y increases by 2. The rate of change is constant. So, the function is linear.

b.

x	0	1	2	3
y	4	8	16	32

(+1, +1, +1 across the x-row; ×2, ×2, ×2 across the y-row)

▶ As x increases by 1, y is multiplied by 2. So, the function is exponential.

STUDY TIP

In Example 1b, consecutive y-values form a constant ratio.

$\frac{8}{4} = 2, \frac{16}{8} = 2, \frac{32}{16} = 2$

EXAMPLE 2 **Evaluating Exponential Functions**

Evaluate each function for the given value of x.

a. $y = -2(5)^x$; $x = 3$ b. $y = 3(0.5)^x$; $x = -2$

SOLUTION

a. $y = -2(5)^x$ Write the function.
$= -2(5)^3$ Substitute for x.
$= -2(125)$ Evaluate the power.
$= -250$ Multiply.

b. $y = 3(0.5)^x$
$= 3(0.5)^{-2}$
$= 3(4)$
$= 12$

Monitoring Progress

Help in English and Spanish at *BigIdeasMath.com*

Does the table represent a *linear* or an *exponential* function? Explain.

1.

x	0	1	2	3
y	8	4	2	1

2.

x	−4	0	4	8
y	1	0	−1	−2

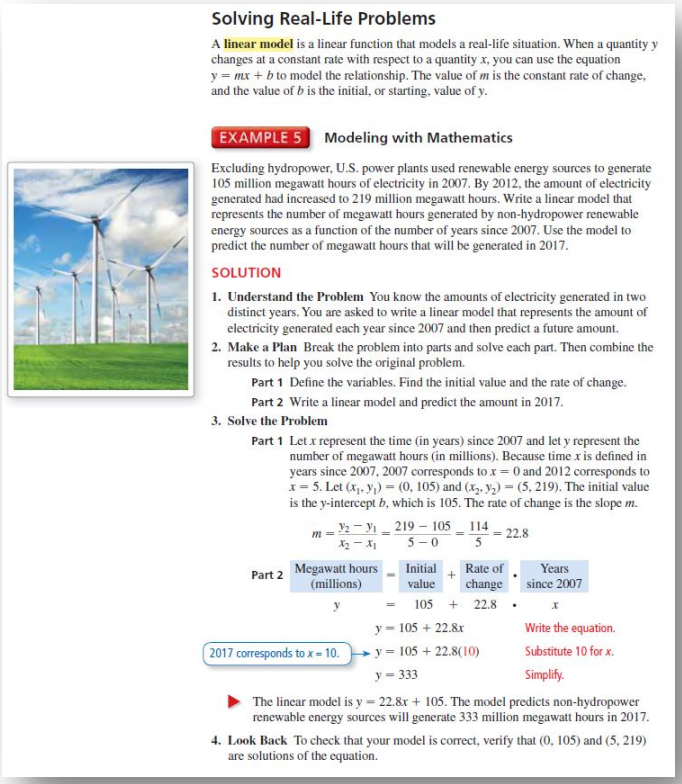
Evaluate the function when $x = -2$, 0, and $\frac{1}{2}$.

3. $y = 2(9)^x$

4. $y = 1.5(2)^x$

Each Exploration is then followed by a teacher guided *Lesson*. These lessons give students the opportunity to develop procedural fluency and to use clear, precise mathematical language. These lessons also give teachers opportunities to use class discussion, flexible grouping, and other delivery methods in their classrooms.

Real-life applications are utilized throughout the program. These applications are opportunities for students to connect classroom lessons to realistic scenarios, and assist teachers with turning mathematical learning into an engaging and meaningful way to explore the real world.



Solving Real-Life Problems

A **linear model** is a linear function that models a real-life situation. When a quantity y changes at a constant rate with respect to a quantity x, you can use the equation $y = mx + b$ to model the relationship. The value of m is the constant rate of change, and the value of b is the initial, or starting, value of y.

EXAMPLE 5 **Modeling with Mathematics**

Excluding hydropower, U.S. power plants used renewable energy sources to generate 105 million megawatt hours of electricity in 2007. By 2012, the amount of electricity generated had increased to 219 million megawatt hours. Write a linear model that represents the number of megawatt hours generated by non-hydropower renewable energy sources as a function of the number of years since 2007. Use the model to predict the number of megawatt hours that will be generated in 2017.

SOLUTION

1. **Understand the Problem** You know the amounts of electricity generated in two distinct years. You are asked to write a linear model that represents the amount of electricity generated each year since 2007 and then predict a future amount.
2. **Make a Plan** Break the problem into parts and solve each part. Then combine the results to help you solve the original problem.
   Part 1 Define the variables. Find the initial value and the rate of change.
   Part 2 Write a linear model and predict the amount in 2017.
3. **Solve the Problem**
   Part 1 Let x represent the time (in years) since 2007 and let y represent the number of megawatt hours (in millions). Because time x is defined in years since 2007, 2007 corresponds to $x = 0$ and 2012 corresponds to $x = 5$. Let $(x_1, y_1) = (0, 105)$ and $(x_2, y_2) = (5, 219)$. The initial value is the y-intercept b, which is 105. The rate of change is the slope m.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{219 - 105}{5 - 0} = \frac{114}{5} = 22.8$$

Part 2

Megawatt hours (millions)	=	Initial value	+	Rate of change	•	Years since 2007
y	=	105	+	22.8	•	x

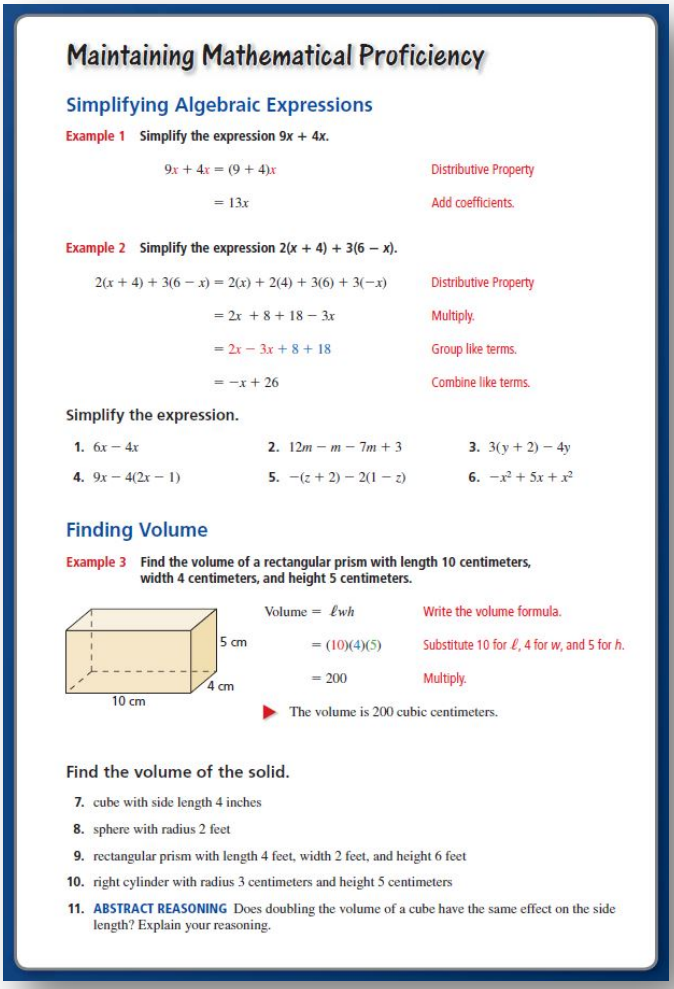
$y = 105 + 22.8x$ Write the equation.

2017 corresponds to $x = 10$. → $y = 105 + 22.8(10)$ Substitute 10 for x.

$y = 333$ Simplify.

▶ The linear model is $y = 22.8x + 105$. The model predicts non-hydropower renewable energy sources will generate 333 million megawatt hours in 2017.

4. **Look Back** To check that your model is correct, verify that (0, 105) and (5, 219) are solutions of the equation.



Maintaining Mathematical Proficiency

Simplifying Algebraic Expressions

Example 1 **Simplify the expression $9x + 4x$.**

$9x + 4x = (9 + 4)x$ Distributive Property

$= 13x$ Add coefficients.

Example 2 **Simplify the expression $2(x + 4) + 3(6 - x)$.**

$2(x + 4) + 3(6 - x) = 2(x) + 2(4) + 3(6) + 3(-x)$ Distributive Property

$= 2x + 8 + 18 - 3x$ Multiply.

$= 2x - 3x + 8 + 18$ Group like terms.

$= -x + 26$ Combine like terms.

Simplify the expression.

1. $6x - 4x$
2. $12m - m - 7m + 3$
3. $3(y + 2) - 4y$
4. $9x - 4(2x - 1)$
5. $-(z + 2) - 2(1 - z)$
6. $-x^2 + 5x + x^2$

Finding Volume

Example 3 **Find the volume of a rectangular prism with length 10 centimeters, width 4 centimeters, and height 5 centimeters.**

Volume $= \ell wh$ Write the volume formula.

$= (10)(4)(5)$ Substitute 10 for ℓ, 4 for w, and 5 for h.

$= 200$ Multiply.

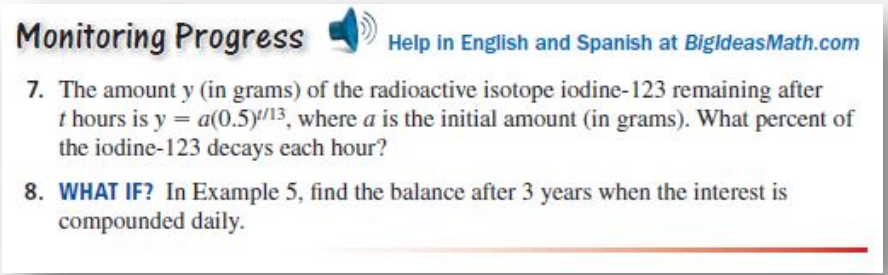
▶ The volume is 200 cubic centimeters.

Find the volume of the solid.

7. cube with side length 4 inches
8. sphere with radius 2 feet
9. rectangular prism with length 4 feet, width 2 feet, and height 6 feet
10. right cylinder with radius 3 centimeters and height 5 centimeters
11. **ABSTRACT REASONING** Does doubling the volume of a cube have the same effect on the side length? Explain your reasoning.

Chapter openers focused on *Maintaining Mathematical Proficiency* promote the development of the habits of mind mathematically proficient students demonstrate.

The Mathematical Practices are woven into every chapter, including a full page dedicated to mastering one of the Mathematical Practices. In addition, *Monitoring Progress* problems allow students to practice and sharpen their skills as they work toward mathematical understanding.



Monitoring Progress

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7. The amount y (in grams) of the radioactive isotope iodine-123 remaining after t hours is $y = a(0.5)^{t/13}$, where a is the initial amount (in grams). What percent of the iodine-123 decays each hour?
8. **WHAT IF?** In Example 5, find the balance after 3 years when the interest is compounded daily.

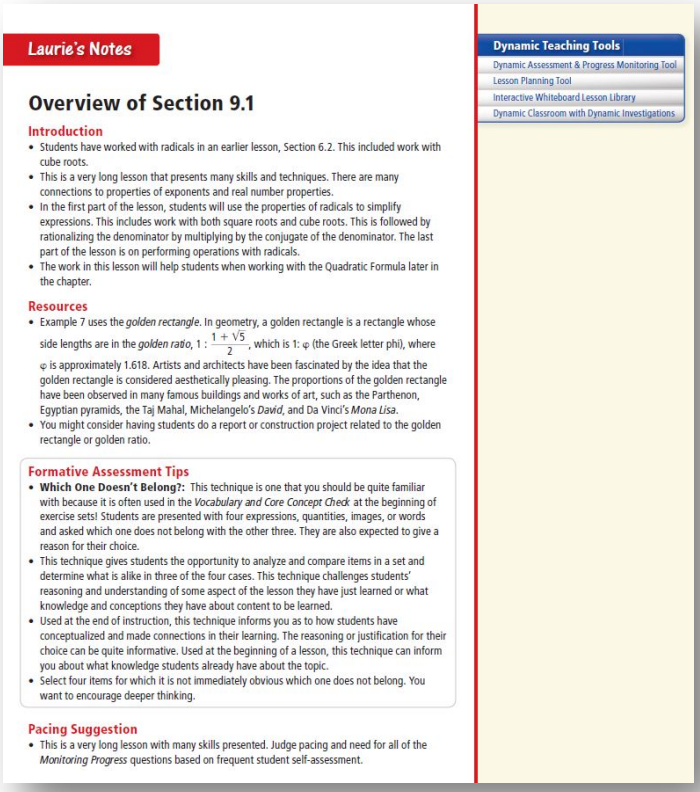
- **Continuous Preparation**

  - Every chapter of the *Big Ideas Math* program utilizes question types frequently found on standardized tests, including the PARCC and Smarter Balanced assessments. The balanced approach to instruction helps students develop the habits of mind required to be successful on high-stakes assessments.

    - The *Exercises* available throughout the *Big Ideas Math* program provide students with opportunities to use multiple approaches to solve problems.
    - The *Dynamic Assessment System* allows teachers to assign homework, quizzes, and tests directly related to the *Big Ideas Math* program to individual students, groups of students, or to an entire classroom.
    - The *Explorations* that begin every section require students to use higher-level thinking to work through each problem and to explain their reasoning in the solution.
    - A *Cumulative Assessment* is included in every chapter. The questions in each assessment were carefully chosen to represent problem types and reasoning patterns frequently found on standardized tests.
    - The *Quizzes* and *Tests* allow students to extend concepts learned in each lesson.
    - The *Online Self-Grading Practice* allows students to receive immediate feedback on their progress.
    - The *Performance Tasks* allow students to apply their knowledge of multiple content standards and work through realistic scenarios.
    - The *Alternative Assessments* provide teachers with the opportunity to assess students on the same content in a variety of ways.

- **Personalized Learning with Complete Teacher Support**

  - The *Big Ideas Math* program offers teachers and students a number of tools to personalize and enrich their classroom experience. Teachers can use *Laurie's Notes*, the *Dynamic Classroom*, and the *Answer Presentation Tool* on a daily basis. Students can use the online *Lesson Tutorial Videos* which are valuable for students who miss a class, need a second explanation, or just need some help with a homework assignment. *Big Ideas Math* completely supports the 3-Tier Response to Intervention Model, so the program can be customized for every level of learner.



Laurie's Notes

Overview of Section 9.1

Introduction

- Students have worked with radicals in an earlier lesson, Section 6.2. This included work with cube roots.
- This is a very long lesson that presents many skills and techniques. There are many connections to properties of exponents and real number properties.
- In the first part of the lesson, students will use the properties of radicals to simplify expressions. This includes work with both square roots and cube roots. This is followed by rationalizing the denominator by multiplying by the conjugate of the denominator. The last part of the lesson is on performing operations with radicals.
- The work in this lesson will help students when working with the Quadratic Formula later in the chapter.

Resources

- Example 7 uses the *golden rectangle*. In geometry, a golden rectangle is a rectangle whose side lengths are in the *golden ratio*, $1 : \frac{1+\sqrt{5}}{2}$, which is 1: φ (the Greek letter phi), where φ is approximately 1.618. Artists and architects have been fascinated by the idea that the golden rectangle is considered aesthetically pleasing. The proportions of the golden rectangle have been observed in many famous buildings and works of art, such as the Parthenon, Egyptian pyramids, the Taj Mahal, Michelangelo's *David*, and Da Vinci's *Mona Lisa*.
- You might consider having students do a report or construction project related to the golden rectangle or golden ratio.

Formative Assessment Tips

- **Which One Doesn't Belong?:** This technique is one that you should be quite familiar with because it is often used in the *Vocabulary and Core Concept Check* at the beginning of exercise sets! Students are presented with four expressions, quantities, images, or words and asked which one does not belong with the other three. They are also expected to give a reason for their choice.
- This technique gives students the opportunity to analyze and compare items in a set and determine what is alike in three of the four cases. This technique challenges students' reasoning and understanding of some aspect of the lesson they have just learned or what knowledge and conceptions they have about content to be learned.
- Used at the end of instruction, this technique informs you as to how students have conceptualized and made connections in their learning. The reasoning or justification for their choice can be quite informative. Used at the beginning of a lesson, this technique can inform you about what knowledge students already have about the topic.
- Select four items for which it is not immediately obvious which one does not belong. You want to encourage deeper thinking.

Pacing Suggestion

- This is a very long lesson with many skills presented. Judge pacing and need for all of the *Monitoring Progress* questions based on frequent student self-assessment.

Dynamic Teaching Tools

- Dynamic Assessment & Progress Monitoring Tool
- Lesson Planning Tool
- Interactive Whiteboard Lesson Library
- Dynamic Classroom with Dynamic Investigations

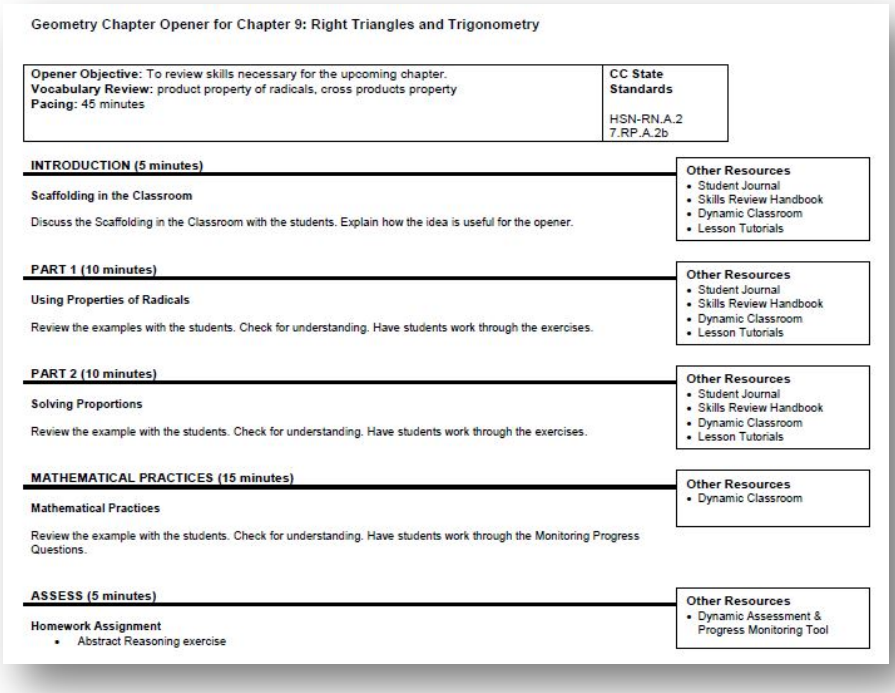
- **Teaching Edition with Laurie's Notes**

  The *Big Ideas Math Teaching Edition* is unique in its organization. Throughout the book, master educator Laurie Boswell shares insights on Learning Progressions and Mathematical Practices.

  Laurie includes connections to previous learning, support for the Mathematical Practices, and closure opportunities for the entire *Student Edition*. The *Teaching Edition* also provides *Differentiated Instruction*, *Response to Intervention*, and *English Language Learner* support.

- **Editable Online Resources**

  Complete and editable *Lesson Plans* and *Pacing Guides* are available online for every lesson in the program to provide teachers with support for planning.



Geometry Chapter Opener for Chapter 9: Right Triangles and Trigonometry

Opener Objective: To review skills necessary for the upcoming chapter.
Vocabulary Review: product property of radicals, cross products property
Pacing: 45 minutes

CC State Standards
HSN-RN.A.2
7.RP.A.2b

INTRODUCTION (5 minutes)
Scaffolding in the Classroom
Discuss the Scaffolding in the Classroom with the students. Explain how the idea is useful for the opener.

Other Resources
- Student Journal
- Skills Review Handbook
- Dynamic Classroom
- Lesson Tutorials

PART 1 (10 minutes)
Using Properties of Radicals
Review the examples with the students. Check for understanding. Have students work through the exercises.

Other Resources
- Student Journal
- Skills Review Handbook
- Dynamic Classroom
- Lesson Tutorials

PART 2 (10 minutes)
Solving Proportions
Review the example with the students. Check for understanding. Have students work through the exercises.

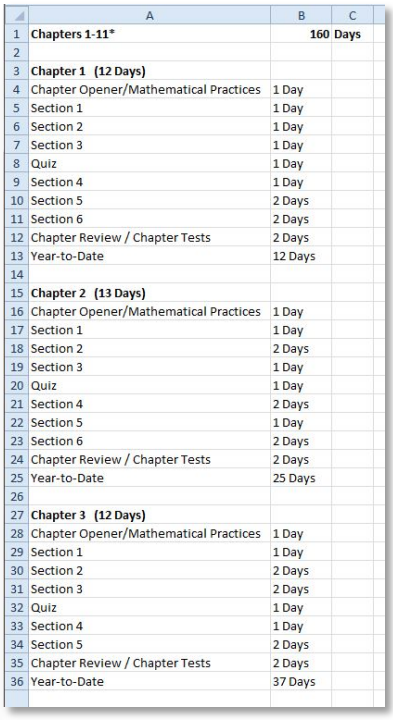
Other Resources
- Student Journal
- Skills Review Handbook
- Dynamic Classroom
- Lesson Tutorials

MATHEMATICAL PRACTICES (15 minutes)
Mathematical Practices
Review the example with the students. Check for understanding. Have students work through the Monitoring Progress Questions.

Other Resources
- Dynamic Classroom

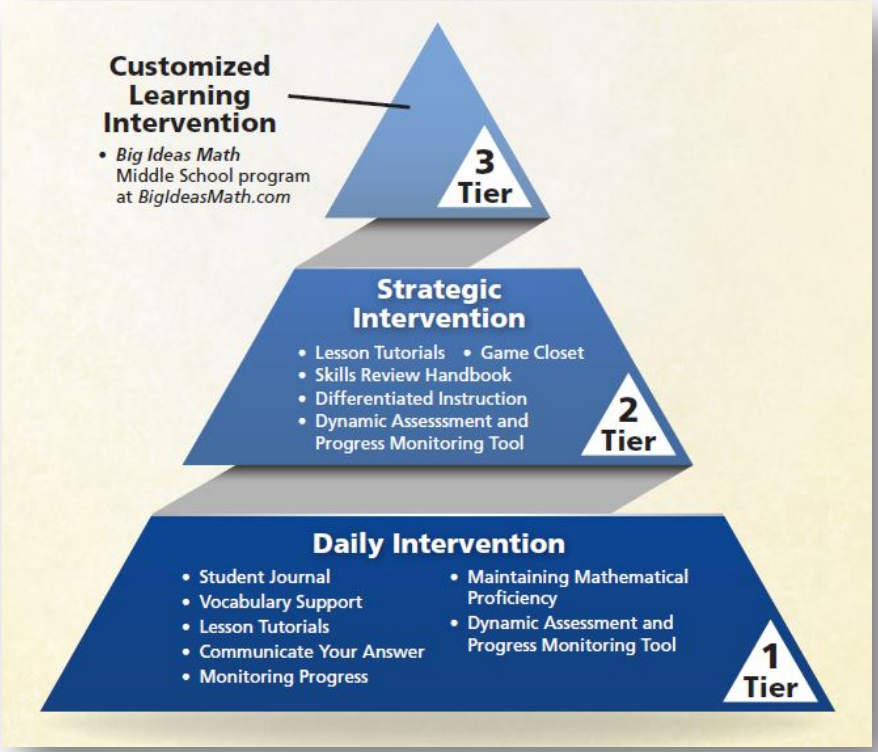
ASSESS (5 minutes)
Homework Assignment
- Abstract Reasoning exercise

Other Resources
- Dynamic Assessment & Progress Monitoring Tool



	A	B	C
1	**Chapters 1-11***	**160**	**Days**
2			
3	**Chapter 1 (12 Days)**		
4	Chapter Opener/Mathematical Practices	1 Day	
5	Section 1	1 Day	
6	Section 2	1 Day	
7	Section 3	1 Day	
8	Quiz	1 Day	
9	Section 4	1 Day	
10	Section 5	2 Days	
11	Section 6	2 Days	
12	Chapter Review / Chapter Tests	2 Days	
13	Year-to-Date	12 Days	
14			
15	**Chapter 2 (13 Days)**		
16	Chapter Opener/Mathematical Practices	1 Day	
17	Section 1	1 Day	
18	Section 2	2 Days	
19	Section 3	1 Day	
20	Quiz	1 Day	
21	Section 4	2 Days	
22	Section 5	1 Day	
23	Section 6	2 Days	
24	Chapter Review / Chapter Tests	2 Days	
25	Year-to-Date	25 Days	
26			
27	**Chapter 3 (12 Days)**		
28	Chapter Opener/Mathematical Practices	1 Day	
29	Section 1	1 Day	
30	Section 2	2 Days	
31	Section 3	2 Days	
32	Quiz	1 Day	
33	Section 4	1 Day	
34	Section 5	2 Days	
35	Chapter Review / Chapter Tests	2 Days	
36	Year-to-Date	37 Days	

- **Differentiated Instruction**
  Through print and digital resources, the *Big Ideas Math* program completely supports the 3-Tier Response to Intervention model. Using research-based instructional strategies, teachers can reach, challenge, and motivate each student with high-quality instruction targeted to individual needs.



Big Ideas Learning works with educators in every step of the development process. Using mathematical and pedagogical research, the *Big Ideas Math* program focuses on fewer topics at each grade level, providing a narrower and deeper course of study that leads students to mastery of each benchmark as they move from grade to grade. Big Ideas Learning provides students and teachers with all the tools they need to succeed from middle school to high school math.

Ron Larson's textbooks are known for their readability, accuracy, and real-life applications. They are used by over five-million students each year. He has been deeply committed to providing innovative and coherent print and online materials to the education community for nearly 40 years.