## Algebraic



Gray • Weilmuenster • Hylemon

## Developed by Texas Educators

 Successfully Bridges Students from Algebra 1 to Algebra 2
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## Algebraic Reasoning

- Developed for the new Algebraic Reasoning Course
- Provides support for Algebra 2
- Developed by Texas Educators
- Student Edition and Teacher Wraparound Edition (TWE)
- Available in print and electronic versions



## About the Authors

Dr. Paul Gray is the Chief Curriculum Officer for Cosenza \& Associates, LLC. As a classroom teacher, Paul taught junior high and senior high mathematics and science. He has also served as an education specialist at the regional level and as director of mathematics and science for an exemplary school district.

Paul's leadership includes curriculum and professional development projects, such as the OnTRACK for College Readiness mathematics courses, and service on the boards of directors for professional organizations. Among them are the Texas Council of Teachers of Mathematics (TCTM), Texas Association of Supervisors of Mathematics (TASM), the CAMT Board of Directors, and the National Council of Supervisors of Mathematics (NCSM).

Paul is also an author of Modeling with Mathematics: A Bridge to Algebra 2, and Math for Financial Literacy. He received his bachelor's degree in meteorology from the University of Oklahoma, and holds his master's degree and doctorate in curriculum and instruction from the
 University of Houston.

## Jacqueline Weilmuenster was named a member of the Expert Review

 Panel for the mathematics standards review in 2011 and was instrumental in giving guidance to the writing committees for the new TEKS. Her credentials include a wealth of experience in education including 38 years in K-12 and higher education, spanning 3 states and 4 job titles.Jacqueline has taught English and mathematics in Austin, Texas, Montville, New Jersey, Nashville, Tennessee, and in the Dallas / Fort Worth area. She has served as a mathematics instructional coach, department chair, K-12 mathematics coordinator, and secondary mathematics coordinator. Jacqueline has also served as an assistant professor in the University of Texas at Arlington's UTeach program.

She has been a trainer for multiple professional development programs, notably the TEXTEAMS Institutes, and consultant for many textbook and instructional materials publishers. She has served on the CAMT Board of Directors as well as the boards of TCTM, TASM, and the Botanical Research Institute of Texas. Her real passion remains working with young people in mathematics instruction.

## Jennifer Hyennon currently serves as the Director of Mathematics in Grapevine-

Colleyville ISD. Her classroom experience includes teaching high school mathematics in both Abilene ISD and Irving ISD as well as university-level mathematics at Cisco Junior College, Northlake College, Texas A\&M University.

Jennifer's campus and district leadership includes service as a coordinator of high school mathematics in Irving ISD and as the Instructional Technology Specialist at The Academy of Irving. Jennifer holds a Master of Science in Mathematics from Texas A\&M and a Bachelor of Science in Mathematics with Teaching from Abilene Christian University.

Jennifer provides leadership for mathematics education at the local and state levels. She is actively involved in the Metroplex Coordinators of Mathematics (McMath). At the state level, Jennifer was appointed by the Texas State Board of Education to serve as a member of the mathematics TEKS revision committee for advanced high school courses. She has been an active member of the Texas Association of Supervisors of Mathematics (TASM) since 2005, including currently serving on the TASM Board of Directors as its Secretary and a Conference for the Advancement of Mathematics Teaching (CAMT) Board Representative, of which she currently serves as the Vice President of the CAMT Board of Directors.

# What is Algebraic Reasoning? 

Algebraic Reasoning is a textbook written by Texas authors to help teachers address the TEKS for the new Algebraic Reasoning high school mathematics course, created by the Texas State Board of Education in 2014.

Consisting of 8 chapters, Algebraic Reasoning contains lessons built on an inquiry-based, 5 E instructional design. Students begin each lesson with a brief Engage activity that ties to prior knowledge or activates mathematics that students will need in that lesson. Next, students explore the concept using technology, pencil-and-paper, or hands-on manipulatives. Important mathematical ideas are formalized in the Explain section, including detailed, stepped-out examples and "You Try It!" problems so that students can immediately check their understanding. Teachers are provided with applications and extensions in the Teacher Wraparound Edition, and students demonstrate their knowledge through practice problems at the end of each section.


## What is in an Algebraic Reasoning Lesson?

The student edition contains 60 lessons, mid-chapter reviews, and end-of-chapter reviews. Each lesson begins with a Focusing Question to set the stage for student inquiry. Students also see their learning outcomes that are written in student-friendly "I can..." statements. Student editions also contain QR codes in each section that link directly to instructional videos that summarize the Explain section and show students how to work the "You Try It!" problems.

The Teacher Wraparound Edition (TWE) contains several features that are intended to help teachers deliver effective instruction. Instructional hints appear throughout the TWE, offering best-practice based suggestions for use of technology, differentiated instruction, and English language learner support.

Teachers also have online access to ancillary material, including mid-chapter and end-ofchapter tests and a bank of editable questions that address content from each section within the chapter.




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Multiple representations, including tables, graphs, and symbolic representations,

## Ancillary Materials

Ancillary materials provided with Algebraic Reasoning include:

- Summary video for the EXPLAIN phase, which teachers could use for students who were absent or with a flipped-classroom instructional model.
- Solution video for each YOU TRY IT! problem that students can use to check or compare their solutions. Students can use these videos for homework help as well.
- Blackline masters for tests to use at the mid-chapter and end-of-chapter for summative assessment.
- Test bank of editable questions that can be used to customize either additional practice or quiz opportunities for formative assessment.


# How Algebraic Reasoning Supports Algebra 2 

Much of the content in the TEKS for Algebraic Reasoning aligns with content in the TEKS for Algebra 2. For some topics, Algebraic Reasoning content lays a conceptual groundwork so that, in subsequent courses such as Algebra 2 , students understand what a topic represents and can dig deeper into algebraic methods and procedures related to that concept.

For example, in both Algebraic Reasoning and Algebra 2, students are expected to formulate systems of three linear equations with three variables (AR.5E and 2A.3A). In Algebraic Reasoning, students turn to matrices to solve these systems and interpret the solutions within the context of the original problem. Hence, students have a conceptual understanding of the problem-solving process when they encounter a real-world problem, represent the problem using a system of linear equations, use a solution strategy (in this case, matrices with technology), and then interpret the solutions. In Algebra 2, students also use algebraic methods, including Gaussian elimination and substitution, to solve these systems. Because students understand the concept of solving a problem using systems of three equations, they can turn to procedures related to algebraic methods as an additional method to compute solutions to the system of equations.

## Algebraic Reasoning

## Algebra 2

> Attributes of Functions

Compare and contrast key attributes of functions $\left(f(x)=x, f(x)=x^{2}, f(x)=\sqrt{x}\right.$, $f(x)=1 / x, f(x)=x^{3}, f(x)=\sqrt[3]{x}, f(x)=b^{x}$, $f(x)=|x|$, and $f(x)=\log _{b}(x)$ where $b$ is 10 or $e$ ) tabularly, graphically, and symbolically (AR.3A).

## Systems of Equations

## Solving Equations

## Modeling with Functions

Use matrices and technology to solve systems of 3 linear equations (AR.5E).

Approximate the solutions to equations related to exponential, logarithmic, square root, and cubic functions (AR.6C).

Use finite differences and average rates of change to determine function models (linear, quadratic, and exponential) for real-world data sets (AR.7D) and use them to solve problems (AR.7C).

Graph and analyze key attributes of graph the functions $f(x)=\sqrt{x}, f(x)=1 / x$, $f(x)=x^{3}, f(x)=\sqrt[3]{x}, f(x)=b^{x}, f(x)=|x|$, and $f(x)=\log _{b}(x)$ where $b$ is 10 or $e$ (2A.2A).

Use matrices, substitution, elimination, and technology to solve systems of 3 linear equations (2A.3B).

Solve exponential and logarithmic equations (2A.5D), square root equations (2A.4F), and cube root equations (2A.6B).

Use regression methods through technology to determine function models (linear, quadratic, exponential) for data sets (2A.8B) and use them to solve problems (2A.8C).

## Contents and TEKS/ELPS Alignment

| CHAPTER 1: ALGEBRAIC PATTERNS | TEKS | ELPS |
| :---: | :---: | :---: |
| 1.1: Arithmetic and Geometric Sequences | AR.2A (A.12C, A.12D) | 3G |
| 1.2: Writing Linear Functions | AR.2A, AR.2C | 1A |
| 1.3: Modeling with Linear Functions | AR.2D | 5B |
| 1.4: Writing Exponential Functions | AR.2A, AR.2B, AR.2C | 5F |
| 1.5: Modeling with Exponential Functions | AR.2B, AR.2D | 5B |
| Mid-chapter Review | AR.2A, AR.2B AR.2C, AR.2D |  |
| 1.6: Writing Quadratic Functions | AR.2A, AR.2C, AR.2D | 5C |
| 1.7: Modeling with Quadratic Functions | AR.2B, AR.2D | 5B |
| 1.8: Writing Cubic Functions | AR.2A, AR.2C, AR.2D | 3D |
| 1.9: Modeling with Cubic Functions | AR.2B, AR.2D | 3F |
| Chapter Review | AR.2A, AR.2B AR.2C, AR.2D |  |
| CHAPTER 2: ANALYZING FUNCTIONS | TEKS | ELPS |
| 2.1: Transforming and Analyzing Linear Functions | AR.3A, AR.7A | 5B |
| 2.2: Transforming and Analyzing Quadratic Functions | AR.3A, AR.7A | 5G |
| 2.3: Transforming and Analyzing Cubic Functions | AR.3A, AR.7A | 1C |
| 2.4: Transforming and Analyzing Absolute Value Functions | AR.3A, AR.7A | 1F |
| Mid-chapter Review | AR.3A, AR.7A |  |
| 2.5: Transforming and Analyzing Rational Functions | AR.3A, AR.7A | 3E |
| 2.6: Transforming and Analyzing Exponential Functions | AR.3A, AR.7A | 1E |
| 2.7: Comparing Sets of Functions | AR.3A, AR.7A | 1C |
| Chapter Review | AR.3A, AR.7A |  |
| CHAPTER 3: INVERSES OF FUNCTIONS | TEKS | ELPS |
| Section 3.1: Generating Inverses of Functions | AR.3B | 4F |
| Section 3.2: Verifying Inverses of Functions | AR.3C | 4C |
| Section 3.3: Square Root Functions | AR.3A, AR.3B, AR.3C | 2C, 3B |
| Mid-chapter Review | AR.3A, AR.3B, AR.3C |  |
| Section 3.4: Cube Root Functions | AR.3A, AR.3B, AR.3C | 1A |
| Section 3.5: Logarithmic Functions | AR.3A, AR.3B, AR.3C | 2I |
| Section 3.6: Comparing and Contrasting Sets of Functions | AR.3A | 1C |
| Chapter Review | AR.3A, AR.3B, AR.3C |  |
| CHAPTER 4: FUNCTION OPERATIONS | TEKS | ELPS |
| Section 4.1: Adding Functions Using Tables and Equations | AR.3D | 2 C |
| Section 4.2: Subtracting Functions Using Tables and Equations | AR.3D | 3D |
| Section 4.3: Adding and Subtracting Functions Using Graphs | AR.3D | 3F |
| Section 4.4: Multiplying Functions | AR.3D | 3D |
| Mid-chapter Review | AR.3D |  |
| Section 4.5: Dividing Functions | AR.3D | 4C |
| Section 4.6: Composing Functions | AR.3E | 2 C |
| Section 4.7: Multiple Representations of Combined Functions | AR.3D, AR.3E | 1A |
| Section 4.8: Modeling with Combined Functions | AR.3D, AR.3E | 2D |
| Chapter Review | AR.3D, AR.3E |  |


| CHAPTER 5: ALGEBRAIC METHODS | TEKS | ELPS |
| :---: | :---: | :---: |
| Section 5.1: Adding and Subtracting Polynomial Functions | AR.4A | 2 C |
| Section 5.2: Multiplying Linear Functions | AR.4A | 5G |
| Section 5.3: Multiplying Polynomial Functions | AR.4C | 5G |
| Section 5.4: Comparing Addition and Multiplication of Linear Functions | AR.3F, AR.4B | 4F |
| Section 5.5: Applying Polynomial Functions | AR.4A | 4F |
| Mid-chapter Review | AR.4A, AR.4B, AR.4C, AR.3F |  |
| Section 5.6: Factoring Polynomials with Graphs and Tables | AR.4D | 4G |
| Section 5.7: Factoring Polynomials with Algebraic Methods | AR.4D | 2D |
| Section 5.8: Decomposing Polynomial Functions | AR.4D | 2I |
| Section 5.9: Dividing Polynomial Functions with Tables | AR.4C | 3H |
| Section 5.10: Dividing Polynomial Functions with Algebraic Methods | AR.4C | 2H |
| Chapter Review | AR.4A, AR.4B, AR.4C, AR.4D |  |
| CHAPTER 6: MATRICES | TEKS | ELPS |
| Section 6.1: Representing Data in Matrices |  | 4F |
| Section 6.2: Adding and Subtracting Matrices | AR.5A | 4F |
| Section 6.3: Scalar Multiplication of Matrices | AR.5C | 4 F |
| Mid-chapter Review | AR.5A, AR.5C |  |
| Section 6.4: Multiplying Matrices | AR.5B | 1F |
| Section 6.5: Solving Systems of Two Linear Equations | AR.5D | 4F |
| Section 6.6: Solving Systems of Three Linear Equations | AR.5E | 4F |
| Chapter Review | AR.5B, AR.5D, AR.5E |  |
| CHAPTER 7: SOLUTIONS OF EQUATIONS | TEKS | ELPS |
| Section 7.1: Estimating Function Values | AR.6A | 2I |
| Section 7.2: Solving Equations Related to Linear Functions | AR.6B | 2D |
| Section 7.3: Solving Equations Related to Quadratic Functions | AR.6B | 5B |
| Section 7.4: Estimating Solutions from Graphs and Tables | AR.6A, AR.6C | 2I, 3F |
| Mid-chapter Review | AR.6A, AR.6B, AR.6C |  |
| Section 7.5: Solving Equations Related to Rational Functions | AR.6A, AR.6B | 1D |
| Section 7.6: Estimating Solutions from Exponential Functions | AR.6A, AR.6C | 3 C |
| Section 7.7: Estimating Solutions from Logarithmic Functions | AR.6A, AR.6C | 4F |
| Section 7.8: Estimating Solutions from Square Root Functions | AR.6A, AR.6C | 4 C |
| Section 7.9: Estimating Solutions from Cubic Functions | AR.6A, AR.6C | 4F |
| Chapter Review | AR.6A, AR.6B, AR.6C |  |
| CHAPTER 8: DATA MODELING | TEKS | ELPS |
| Section 8.1: Modeling with Linear Functions | AR.7E, AR.7B, AR.7C, AR.7D | 4 C |
| Section 8.2: Modeling with Quadratic Functions | AR.7B, AR.7C, AR.7D | 2 E |
| Section 8.3: Modeling with Exponential Functions | AR.7B, AR.7C, AR.7D | 4F |
| Section 8.4: Modeling with Rational Functions | AR.7A, AR.7B, AR.7D | 4G |
| Section 8.5: Comparing Functional Models | AR.7A, AR.7B, AR.7D | 4 E |
| Chapter Review | AR.7E, AR.7B, AR.7C, AR.7D |  |

## Key Features of Algebraic Reasoning

- Developed by Texas Educators
- Developed specifically for the Algebraic Reasoning TEKS
- Bridges students from Algebra 1 to Algebra 2
- Exploration activities
- Explanation videos
- Practice videos
- Teacher question bank

- Chapter and mid-chapter reviews
- Chapter and mid-chapter tests
- Available in both print and electronic formats
- ELPS support
- Differentiation support
- Technology integration
- Questioning strategies
- Additional examples in the TWE


Use the QR code to visit www.cosenzaassociates.com to learn more about Algebraic Reasoning.

- View textbook and eBook pricing and ordering information.
- View and / or download a sample chapter of Algebraic Reasoning.



## Algebraic Reasoning will be available in both print and eBook formats in summer 2016!

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