Algebraic Reasoning
Overview
2022-2023

This document is designed provide parents/guardians/community an overview of the curriculum taught in the FBISD classroom. This document supports families in understanding the learning goals for the course, and how students will demonstrate what they know and are able to do. The overview offers suggestions or possibilities to reinforce learning at home.

Included at the end of this document, you will find:

- A glossary of curriculum components
- The content area instructional model
- Parent resources for this content area

To advance to a particular grading period, click on a link below.

- Grading Period 1
- Grading Period 2
- Grading Period 3
- Grading Period 4

At Home Connections

The following are suggestions for reinforcing number sense and mathematical reasoning at home. These ideas can be used throughout the school year. You will find additional ideas to reinforce learning at home within each unit below.

- Ask questions that require students to describe and elaborate on their thinking and reasoning. Topics can be about everyday things as well as mathematics.
- Engage students in situations that challenge them to inquire and persevere through questioning.
- Play card games with students
- Play games with students such as Mancala, Yahtzee, Blokus, Rack-O, Mastemind, etc.
- Work number puzzles such as Sudoku, KenKen, Kakuro, or Numbrix.

Process Standards

The process standards describe ways in which students are expected to engage in the content. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use knowledge learned efficiently and effectively in daily life.

AR.1A Apply mathematics to problems arising in everyday life, society, and the workplace
A.R1B Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution
AR.1C Select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems
AR.1D Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate
AR.1E Create and use representations to organize, record, and communicate mathematical ideas
AR.1F Analyze mathematical relationships to connect and communicate mathematical ideas
AR.1G Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication

Grading Period 1

Unit 1: Patterns and Functions

Estimated Date Range: Aug. 10 – Sept. 9
Estimated Time Frame: 22 days

Unit Overview:
In this unit, students will analyze patterns in data to determine which type of function the data represents. Students will build on their knowledge of arithmetic and geometric sequences from Algebra 1 to develop an understanding of patterns in data. Students will also relate their knowledge of a common ratio to determine first finite, second finite, and third finite differences in order to classify tables of values as either a linear, quadratic, cubic, or exponential function. Students will apply their understanding of finite differences to determine models for real world data.

At home connections:

- Have your student research patterns and sequences that occur in nature.
- Have your students explain the difference between different functions – linear, quadratic, exponential and cubic functions.

Concepts within Unit #1 **Link to TEKS**	**Success Criteria for this concept**
Establishing a Positive Mathematics Community TEKS: AR.1A, AR.1B, AR.1C, AR.1D, AR.1E, AR.1G, AR.1G	• Demonstrate active listening skills while sharing in the community circle. • Make positive and supportive connections with my peers. • Engage in circle dialogues using the circle guidelines. • Share my math ideas and strategies when given a problem during the number sense routine. • Explain what a Respect Agreement is and why it is created. • Work in a group to solve a mathematical problem. • Describe strategies that I can use to solve math problems. • Provide feedback to by peers using guidelines and a protocol.
Concept #1: Sequences TEKS: AR.2A	• Determine the common difference of a sequence • Write an equation for an arithmetic sequence from visual patterns, lists of numbers, graphs, and verbal descriptions. • Verify that a recursive function and an explicit function represent the same arithmetic sequence • Find any term of a sequence using the equation representing the arithmetic sequence Determine the common ratio of a sequence • Write an equation for an geometric sequence from visual patterns, lists of numbers, graphs, and verbal descriptions. • Verify that a recursive function and an explicit function represent the same geometric sequence • Find any term of a sequence using the equation representing the geometric sequence
Concept #2: Patterns and Linear Functions TEKS: AR.2A, AR.2B, AR.2C, AR.2D	• Determine the finite difference from a table of values that represents real-world or mathematical data • Determine the y-intercept from a table of values that represents real-world or mathematical data • Explain that if the finite differences between consecutive y-values in a table are constant, the values represent a linear function.

	• Write a linear function in the form $f(x) = ax + b$, where *a* represents the finite difference and *b* represents the y-value of the y-intercept (0, *b*) • Make connections between arithmetic sequences and linear functions. • Use the linear function model I determined to make predictions about the situation. • Examine the reasonableness of the prediction I made using the model I determined
Concept #3: Patterns and Exponential Functions TEKS: AR.2A, AR.2B, AR.2D	• Determine from a table if data represents a linear or an exponential model. • Determine from a table if data represents a linear or an exponential model by finding if there is a finite difference or common ratio. • Determine the common ratio from a table of values that represents real-world or mathematical data • Determine the y-intercept from a table of values that represents real-world or mathematical data • Explain that if the ratios of successive values of the dependent variables in a table of values is constant, the values represent an exponential function. • Write an exponential function in the form $f(x) = ab^x$, where *b* represents the common ratio and *a* represents the y-value of the y-intercept (0, *a*) • Make connections between geometric sequences and exponential functions. • Use the exponential function model I determined to make predictions about the situation. • Examine the reasonableness of the prediction I made using the model I determined
Concept #4: Patterns and Quadratic Functions TEKS: AR.2A, AR.2B, AR.2C, AR.2D	• Determine from a table if data represents a linear, exponential or quadratic model by finding if there is a common first difference, second difference or common ratio. • Determine the first and second differences from a table of values that represents real-world or mathematical data • Determine the y-intercept from a table of values that represents real-world or mathematical data • Explain that if the second differences between consecutive y-values in a table are constant, the values represent a quadratic function. • Write a quadratic function in the form $f(x) = ax^2 + bx + c$, where 2*a* represents the second difference, a + b is equal to the first difference between the y-values for x=0 and x=1, and *c* represents the y-value of the y-intercept (0, *c*). • Use the quadratic function model I determined to make predictions about the situation. • Examine the reasonableness of the prediction I made using the model I determined
Concept #2: Patterns and Cubic Functions TEKS: AR.2A, AR.2B, AR.2C, AR.2D	• Determine from a table if data represents a linear, exponential, quadratic, or cubic model by finding if there is a common first difference, second difference, third difference or common ratio. • Determine the first, second, and third differences from a table of values that represents real-world or mathematical data • Determine the y-intercept from a table of values that represents real-world or mathematical data • Explain that if the third differences between consecutive y-values in a table are constant, the values represent a cubic function. • Write a quadratic function in the form $f(x) = ax^3 + bx^2 + cx + d$, where 6*a* represents the third difference, 6a +2b is equal to the second difference between

	the y-values for x=0 and x=1, a = b= c is equal to the first difference between the y-values for x=0 and x=1, and *d* represents the y-value of the y-intercept (0, *d)*. • Use the cubic function model I determined to make predictions about the situation. • Examine the reasonableness of the prediction I made using the model I determined

Unit 2: Analyzing Functions

Estimated Date Range: Sept. 12 – Oct. 7
Estimated Time Frame: 19 days

Unit Overview:
In this unit, students will continue their study of functions. In Algebra 1, students studied linear, quadratic, and exponential functions, studied the key features of linear, quadratic and exponential graphs, and graphed using transformations linear and quadratic functions. In this unit, students will graph linear, quadratic and exponential graphs using transformations. Students will also be introduced to the square root and absolute value functions. Students will apply their understanding of transformations to graph these functions using transformations. Once students have graphed functions, they will identify and analyze the key features. Students will then compare key features of sets of functions from graphs, tables and symbolic representations. The sets they compare will be linear, quadratic, and exponential or absolute value, quadratic, and square root.

At home connections:
- Discuss and research real-world applications of linear, quadratic, exponential, absolute value ,and square root functions.
- Discuss similarities and differences between the different types of functions.

Concepts within Unit # 2 Link to TEKS	Success Criteria for this concept
Concept #1: Transformations of Functions TEKS: AR.3A, AR.7A	• Graph linear, quadratic, exponential, absolute value, and square root functions using transformations. • Write domain and range in inequalities, interval notation, and set building notation. • Identify key features of functions from graphs, tables, and symbolic representations.
Concept #2: Compare Key Features of Sets of Functions TEKS: AR.3A, AR.7A	• Describe similarities and differences in key features of a set of linear, quadratic, and exponential functions from symbolic representations, graphs and tables. • Describe similarities and differences in key features of a set of absolute value, quadratic, and square root functions from symbolic representations, graphs and tables.

Grading Period 2

Unit 3: Inverses of Functions

Estimated Date Range: Oct. 11 – Nov. 4
Estimated Time Frame: 18 days

Unit Overview:

In this unit, students will continue their study of functions by studying inverse functions. Students will determine inverses from graphs, tables and symbolic representations. Students will compare and contrast the key features of a function and its inverse. Students will also verify inverses graphically and tabularly.

At home connections:

- Discuss what the word inverse means (not just mathematically) and how it relates to mathematics and functions.

Concepts within Unit # 3 Link to TEKS	Success Criteria for this concept
Concept #1: Inverses of Linear and Absolute Value Functions TEKS: AR.3B, AR.3C, AR.7A, AR.7B	• Find the inverse of a linear function graphically, tabularly, and symbolically. • Find the inverse of an absolute value function graphically, tabularly, and symbolically. • Verify functions are inverses tabularly and graphically. • Compare and contrast the key features of a linear function and its inverse. • Compare and contrast the key features of an absolute value function and its inverse.
Concept #2: Inverses of Quadratic and Square Root Functions TEKS: AR.3B, AR.3C, AR.7A, AR.7B	• Find the inverse of a quadratic function graphically, tabularly, and symbolically. • Find the inverse of square root function graphically, tabularly, and symbolically. • Recognize that the inverse of a quadratic (not restricted) is two square root functions. • Recognize that the inverse of a square root function is a restricted quadratic function. • Verify functions are inverses tabularly and graphically. • Compare and contrast the key features of a quadratic function and its inverse. • Compare and contrast the key features of square root function and its inverse.
Concept #3: Inverses of Rational Functions TEKS: AR.3B, AR.3C, AR.7A, AR.7B	• Graph the rational parent graph. • Identify key features of the rational parent graph. • Graph a rational graph from transformations. • Identify key features of a rational graph. • Find the inverse of a rational function graphically, tabularly, and symbolically. • Recognize that the inverse of a rational function is a rational function. • Verify functions are inverses tabularly and graphically. • Compare and contrast the key features of a rational function and its inverse.
Concept #4: Inverses of Cubic and Cube Root Functions TEKS: AR.3B, AR.3C, AR.7A, AR.7B	• Find the inverse of a cubic function graphically, tabularly, and symbolically. • Understand the inverse of a cubic is a function called the cube root function. • Find the inverse of a cube root function graphically, tabularly, and symbolically. • Verify functions are inverses tabularly and graphically. • Compare and contrast the key features of an cubic function and its inverse.
Concept #5: Inverses of Exponential and Logarithmic Functions TEKS: AR.3B, AR.3C, AR.7A, AR.7B	• Find the inverse of an exponential function graphically, tabularly, and symbolically. • Understand the inverse of an exponential is a function called the log function. • Verify functions are inverses tabularly and graphically. • Compare and contrast the key features of an exponential quadratic function and its inverse.

Unit 4: Operations of Functions

Estimated Date Range: Nov. 7 – Nov. 18 and Nov. 28 – Dec. 16
Estimated Time Frame: 25 days
Note: Includes 7 days for semester exams and review

Unit Overview:
In this unit, students will continue their study of functions. Students will add, subtract, multiply, and divide functions together in order to generate new functions. Students will perform operations symbolically (operations on equations), tabularly, and graphically. Students should make the connection between the representations when performing operations. Students will also explore composition by examining how the output of one function is the input of another function.

At home connections:

- Discuss real world situations where constructing or deconstructing parts of the situation is helpful.

Concepts within Unit # 4 **Link to TEKS**	**Success Criteria for this concept**
Concept #1: Constructing and Deconstructing Functions TEKS: AR.3D, AR.3F	• Add and subtract functions tabularly, graphically, and symbolically. • Multiply functions tabularly, graphically, and symbolically. • Divide functions tabularly, graphically, and symbolically. • Represent real world situations as functions that are constructed from other functions.
Concept #2: Composing and Decomposing Functions TEKS: AR.3E	• Compose functions tabularly, graphically, and symbolically. • Decompose functions tabularly, graphically, and symbolically. • Represent real world situations as functions that are composed of other functions.

Grading Period 3

Unit 5: Polynomial Functions

Estimated Date Range: Jan 5 – Feb. 3
Estimated Time Frame: 21 days

Unit Overview:
In this unit, students will extend their knowledge from operations (add, subtract, multiply, and divide) of polynomials of degree one and degree two to general polynomial functions. Students will use tables, graphs and equations to add, subtract, multiply, and divide polynomial functions in order to solve problems arising from real-world situations, compare and contrast the sum or product of two linear functions, factor polynomials using graphs, tables, and algebraic methods, divide polynomial functions using tables and determine the linear factors of polynomial functions from tables, graphs, or symbolic representations

At home connections:

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Concepts within Unit # 6 Link to TEKS	Success Criteria for this concept
Concept #1: Operations of Linear Functions TEKS: AR.4B	• Complete a table of values of *f(x)*, *g(x)*, and *(f+g)(x)* and use the table to compare and contrast the intercepts and slope. • Use finite differences to classify and write a function rule for *(f+g)(x).* • Graph *f(x)*, *g(x)*, and *(f+g)(x)* on the same coordinate plane and use the graphs to compare and contrast the intercepts and slope. • Complete a table of values of *f(x)*, *g(x)*, and *(f×g)(x)* and use the table to compare and contrast the intercepts. • Use the table to compare the sign of the function values for both *f(x)* and *g(x)* to *(f×g)(X).* • Use finite differences to classify and write a function rule for *(f×g)(x).* • Graph *f(x)*, *g(x)*, and *(f×g)(x)* on the same coordinate plane and use the graphs to compare and contrast the intercepts.
Concept #2: Applications of Operations of Polynomial Functions TEKS:AR.4A, AR.4B	• Construct tables of values to show relationship between the term number a pattern represented with color tiles and cubes. • Create a combined sequence with the color tiles and cubes and by adding a second sequence to the table. • Apply tables to find surface area and volume of 3 dimensional objects. • Use finite differences or successive ratios to determine the function rule in order to connect the symbolic and tabular representations.
Concept #3: Division of Polynomial Functions TEKS: AR.4C	• Use tables to divide polynomials of degree three or four by polynomials of degree one or two • Use long division to divide polynomials of degree three or four by polynomials of degree one or two • Use synthetic division to divide polynomials of degree three or four by polynomials of degree one and two
Concept #4: Factors of Polynomial Functions TEKS: AR.4C, AR.4D	• Factor polynomial functions of degree two and of degree three using algebraic methods such as factor by grouping

	• Factor the sum and difference of squares and cubes • Factor perfect square trinomials • Factor perfect cube polynomials

Unit 6: Matrices

Estimated Date Range: Feb. 6 – March 10
Estimated Time Frame: 23 days

Unit Overview:
In this unit, students will perform operations with matrices. Students will represent situations with systems of two and three linear equations and use matrices to solve the systems.

At home connections:

- Discuss and research real life applications of matrices.
- Discuss situations where more than one equation is need to solve.

Concepts within Unit # 6 Link to TEKS	Success Criteria for this concept
Concept #1: Adding and Subtracting Matrices TEKS: AR.5A	• Create matrices to display given information. • Add and subtract matrices, with technology, in mathematical and real-world situations. • Add and subtract matrices, without technology, in mathematical and real-world situations. • Explain the meaning of the values in resulting matrix as it relates to the situation.
Concept #2: Multiplying Matrices TEKS: AR.5B, AR.5C	• Create matrices to represent given information. • Determine if two matrices can be multiplied. • Multiply one matrix by another matrix using technology and explain what the product of the two matrices represent. • Multiply a data set that is represented in a matrix by a scalar with and without technology. • Explain the meaning of the values in each matrix and why they are performing the operation.
Concept #3: Systems of Equations TEKS: AR.5B, AR.5C, AR.5D, AR.5E	• Represent a situation using a system of three linear equations. • Determine the inverse of a matrix. • Solve systems of three linear equations using matrices.

Grading Period 4

Unit 7: Solutions of Equations

Estimated Date Range: Mar. 20 – April 21
Estimated Time Frame: 23 days

Unit Overview:

In this unit, students will estimate and determine solutions to equations resulting from functions and real-world applications. Students will work with linear, quadratic, rational, exponential, logarithmic, square root, and cubic functions.

At home connections:

- Discuss how estimation helps us solve problems and how we use estimation in our everyday lives.

Concepts within Unit # 7 Link to TEKS	Success Criteria for this concept
Concept #1: Estimating Solutions to Equations TEKS: AR.6A	• Locate a point that has a *y*-coordinate equal to the output value from a graph. • Locate corresponding input value in the independent variable for a given output value in the dependent variable. • Use the input values that correspond to the nearby output values to estimate the input value for the given output value. • Use an equation and the given output value to work backwards using inverse operations and estimation strategies to estimate an input value for a given output value.
Concept #2: Solving Linear and Quadratic Equations TEKS:AR.6A, AR.6B	• Write an equation that models a linear function for real-world situations. • Solve linear equations graphically, tabularly, and symbolically. • Write an equation that models a quadratic function for real-world situations • Solve quadratic equations graphically, tabularly, and symbolically.
Concept #3: Estimating Solutions to Exponential, Logarithmic, Square Root, and Cubic Functions TEKS: AR.6A, AR.6B, AR.6C	• Approximate a solution to an exponential equation using tables or graphs. • Approximate a solution to a logarithmic equation using tables or graphs. • Approximate a solution to a square root equation using tables or graphs. • Approximate a solution to a cubic equation using tables or graphs.

Unit 8: Data Modeling

Estimated Date Range: April 24 – May 25
Estimated Time Frame: 24 days
Note: Includes 7 days for semester exams and review

Unit Overview:
In this unit, students will extend their knowledge of regression models. In Algebra 1, students determined regression models for linear, quadratic and exponential data and used the regression model to make predictions in context of the situation. In Algebraic Reasoning, given a set of data, students will determine which model best represents the data, determine the regression model and then use the model to make predictions.

At home connections:

- Research and discuss real life applications of data modeling.
- Collect data, graph the data, create a regression model and use the model to make predictions.

Concepts within Unit # 8 **Link to TEKS**	**Success Criteria for this concept**
Concept #1: Examining Domain and Range of Real World Data TEKS: AR.7A, AR.7B	• Determine whether a particular real world data set is discrete or continuous • Write the domain and range to match using interval notation, inequalities, and set builder notation. • Identify situations where the mathematical and reasonable domain and range are different and be able to identify the mathematical domain and range limitations. • Compare and contrast the reasonableness of the mathematical and real-world domain and range of linear, quadratic, exponential, and rational functions.
Concept #2: Determining Functions Models from Data TEKS: AR.7A, AR.7B, AR.7D, AR.7E	• Determine an appropriate function model for real-world data (linear, quadratic, and exponential) using finite differences • Determine an appropriate function model for real-world data (linear, quadratic, and exponential) using average rates of change • Determine the function rule for a set of real-world data. • Determine if a given linear function is a reasonable model for a set of data arising from a real-world situation.
Concept #3: Predicting using Models TEKS: AR.7A, AR.7B, AR.7C, AR.7D, AR.7E	• Gather, organize, analyze, and evaluate data based on its function shape. • Compare the mathematical domain and range of the function model to the reasonable domain and range for which the function models the data • Determine accuracy of a prediction using finite differences and average rates of change • Explain the differences between the predictions' accuracy

Glossary of Curriculum Components

Overview– The content in this document provides an overview of the pacing and concepts covered in a subject for the year.
TEKS – Texas Essential Knowledge and Skills (TEKS) are the state standards for what students should know and be able to do.
Unit Overview – The unit overview provides a brief description of the concepts covered in each unit.
Concept – A subtopic of the main topic of the unit.
Success Criteria—a description of what it looks like to be successful in this concept.

Parent Resources

The following resources provide parents with ideas to support students' understanding. For sites that are password protected, your child will receive log-in information through their campus.

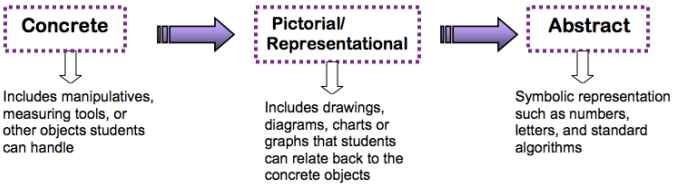
Resource	How it supports parent and students
Didax Virtual Manipulatives Math Learning Center Math Apps Polypad: Mathigon – Virtual Manipulatives	These online resources provide access to virtual manipulatives.
Parent Resources from youcubed.org	This resource from youcubed.org includes articles for parents on ways to support their students in learning and understanding mathematics.
Student Resources from youcubed.org	This resource from youcubed.org includes videos concerning growth mindset in mathematics.
Math: Why Doesn't Yours Look Like Mine?	This resource provides an explanation of why math looks different now as opposed to how parents learned mathematics and how to support students in learning mathematics.

Supplemental Resource and Tool Designation:

- The TI Nspire CX calculator is a standardized technology integration tool used for Mathematics and Science in FBISD.

Instructional Model

The structures, guidelines or model in which students engage in a particular content that ensures understanding of that content.



The instructional model for mathematics is the Concrete-Representational-Abstract Model (CRA).
The CRA model allows students to access mathematics content first through a concrete approach ("doing" stage) then representational ("seeing" stage) and then finally abstract ("symbolic" stage). The CRA model allows students to

conceptually develop concepts so they have a deeper understanding of the mathematics and are able to apply and transfer their understanding across concepts and contents. The CRA model is implemented in grades K-12 in FBISD.