TEKS Clarification

Mathematics

High School Courses, Algebra I
2014 - 2015

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HIGH SCHOOL COURSES, ALGEBRA I	
§111.31. Implementation of Texas Essential Knowledge and Skills for Mathematics, Grades 9-12.	
The provisions of this subchapter shall be implemented beginning with the 2006-2007 school year. This implementation date shall supersede any other implementation dates found in this subchapter.	
Source: The provisions of this §111.31 adopted to be effective September 1, 1996, 21 TexReg 7371; amended to be effective August 1, 2006, 30 TexReg 4479.	
§111.32. Algebra I (One Credit).	
A.Basic.1	Foundation concepts for high school mathematics. As presented in Grades K-8, the basic understandings of number, operation, and quantitative reasoning; patterns, relationships, and algebraic thinking; geometry; measurement; and probability and statistics are essential foundations for all work in high school mathematics. Students will continue to build on this foundation as they expand their understanding through other mathematical experiences.
A.Basic.2	Algebraic thinking and symbolic reasoning. Symbolic reasoning plays a critical role in algebra; symbols provide powerful ways to represent mathematical situations and to express generalizations. Students use symbols in a variety of ways to study relationships among quantities.
A.Basic.3	Function concepts. A function is a fundamental mathematical concept; it expresses a special kind of relationship between two quantities. Students use functions to determine one quantity from another, to represent and model problem situations, and to analyze and interpret relationships.
A.Basic.4	Relationship between equations and functions. Equations and inequalities arise as a way of asking and answering questions involving functional relationships. Students work in many situations to set up equations and inequalities and use a variety of methods to solve them.

A.Basic.5	Tools for algebraic thinking. Techniques for working with functions and equations are essential in understanding underlying relationships. Students use a variety of representations (concrete, pictorial, numerical, symbolic, graphical, and verbal), tools, and technology (including, but not limited to, calculators with graphing capabilities, data collection devices, and computers) to model mathematical situations to solve meaningful problems.
A.Basic.6	Underlying mathematical processes. Many processes underlie all content areas in mathematics. As they do mathematics, students continually use problem-solving, language and communication, and reasoning (justification and proof) to make connections within and outside mathematics. Students also use multiple representations, technology, applications and modeling, and numerical fluency in problem-solving contexts.

A.1	***Foundations for functions. The student understands that a function represents a dependence of one quantity on another and can be described in a variety of ways. The student is expected to:***

A.1A	**Describe independent and dependent quantities in functional relationships.**
	Supporting Standard
	
	Understand, Describe, Represent
	
	INDEPENDENT AND DEPENDENT QUANTITIES IN FUNCTIONAL RELATIONSHIPS
	
	Including, but not limited to:
	
	• Identification of independent and dependent quantities in real-world problem situations
	• Verbal descriptions of dependency relationships
	• Representations of relationships between independent and dependent quantities in functional relationships with and without technology
	  ◦ Verbal descriptions
	  ◦ Algebraic generalizations (including equation and function notation)
	
	TxCCRS:
	
	• VII. Functions B1 – Understand and analyze features of a function.

A.1B	**Gather and record data and use data sets to determine functional relationships between quantities.** ***Supporting Standard*** Represent, Describe, Gather, Record, Use, Determine FUNCTIONAL RELATIONSHIPS OF DATA SETS

Including, but not limited to:

- Data involving measurement activities, models, simulations, and real-world problem situations
- Data representing linear and nonlinear models
- Representations of functional relationships with and without technology
  - Models
    - Concrete
    - Pictorial
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Connections between representations of functional relationships with and without technology
- Analysis of data for predictions and conclusions (TxCCRS)
- Comparisons between functional and non-functional relations (TxCCRS)

TxCCRS:

- II. Algebraic Reasoning D1 – Interpret multiple representations of equations and relationships.
- VI. Statistical Reasoning B1 – Determine types of data.
- VI. Statistical Reasoning C1 – Make predictions and draw inferences using summary statistics.
- VII. Functions A1 – Recognize whether a relation is a function.
- VII. Functions A2 – Recognize and distinguish between different types of functions.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C2 – Develop a function to model a situation.

A.1C

Describe functional relationships for given problem situations and write equations or inequalities to answer questions arising from the situations.

Supporting Standard

Describe

FUNCTIONAL RELATIONSHIPS FOR PROBLEM SITUATIONS

Including, but not limited to:

- Real-world problem situations

- Representations of functional relationships
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
    - Equations
    - Inequalities
- Connections between representations of functional relationships

Write

EQUATIONS AND INEQUALITIES IN PROBLEM SITUATIONS

Including, but not limited to:

- Real-world problem situations
- Representations of functional relationships
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
    - Equations
    - Inequalities

Answer

QUESTIONS ARISING FROM PROBLEM SITUATIONS

Including, but not limited to:

- Analysis of solutions for predictions and conclusions arising from problem situations
- Comparison of solutions to equations and inequalities in a problem situation (TxCCRS)
- Justification of reasonableness of solution

Note(s):

- In middle school, students formulate equations from problem situations.
- TxCCRS:
  - II. Algebraic Reasoning C2 – Explain the difference between the solution set of an equation and the solution set of an inequality.
  - II. Algebraic Reasoning D1 – Interpret multiple representations of equations and relationships.
  - II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.

- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C2 – Develop a function to model a situation.

A.1D

Represent relationships among quantities using concrete models, tables, graphs, diagrams, verbal descriptions, equations, and inequalities.

Readiness Standard

Represent

RELATIONSHIPS AMONG QUANTITIES

Including, but not limited to:

- Sets of related data
- Representations of relationships with and without technology
  - Models
    - Concrete
    - Pictorial (e.g., mappings)
  - Tables
  - Graphs
    - Equations
      - Solid line
    - Inequalities
      - Solid or dotted line with shading on one side
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
    - Equations
      - $y = 2x + 3$ or $f(x) = 2x + 3$
    - Inequalities
      - $y < 2x + 3$
- Connections between representations of relationships with and without technology
- Analysis of data for predictions and conclusions (TxCCRS)
- Identification of certain relations as functions (TxCCRS)

Note(s):

- In middle school, students generate different representations of data from other representations. (TEKS 8.4A)
- TxCCRS:
  - II. Algebraic Reasoning D1 – Interpret multiple representations of equations and relationships.
  - II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.
  - VI. Statistical Reasoning B2 – Select and apply appropriate visual representations of data.
  - VII. Functions A1 – Recognize whether a relation is a function.
  - VII. Functions B1 – Understand and analyze features of a function.
  - VII. Functions B2 – Algebraically construct and analyze new functions.
  - VII. Functions C2 – Develop a function to model a situation.
  - IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.
  - IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
  - IX. Communication and Representation C1– Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.

A.1E

Interpret and make decisions, predictions, and critical judgments from functional relationships.

Readiness Standard

Interpret, Make

DECISIONS, PREDICTIONS, AND CRITICAL JUDGMENTS FROM FUNCTIONAL RELATIONSHIPS

Including, but not limited to:

- Data sets and real-world problem situations
- Representations of functional relationships with and without technology
  - Tables
  - Graphs, including situational
  - Verbal descriptions
  - Algebraic generalizations
- Connections between representations of functional relationships with and without technology
- Analysis of data representations for predictions and conclusions with and without technology

Note(s):

- In middle school, students predict, find, and justify solutions using various representations.
- TxCCRS:
  - II. Algebraic Reasoning D1 – Interpret multiple representations of equations and relationships.
  - VI. Statistical Reasoning C1 – Make predictions and draw inferences using summary statistics.

A.2	***Foundations for functions. The student uses the properties and attributes of functions. The student is expected to:***
A.2A	**Identify and sketch the general forms of linear ($y = x$) and quadratic ($y = x^2$) parent functions.** ***Supporting Standard***

Identify, Sketch

LINEAR AND QUADRATIC PARENT FUNCTIONS

Including, but not limited to:

- General form of the linear parent function: $y = x$
- General form of the quadratic parent function: $y = x^2$
- Representations of parent functions with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Properties of representative parent functions
  - Domain
  - Range
  - Attributes (e.g., intercepts, minimum/maximum, symmetry, increasing/decreasing, rate of change, etc.)
- Connections between transformed linear functions to the respective parent function with and without technology
- Connections between transformed quadratic functions to the respective parent function with and without technology
- Similarities and differences in the parent functions $y = x$ and $y = x^2$
- Identification of certain relations as functions (TxCCRS)

TxCCRS:

- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions A1 – Recognize whether a relation is a function.

- VII. Functions A2 – Recognize and distinguish between different types of functions.
- VII. Functions B1 – Understand and analyze features of a function.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.2B

Identify mathematical domains and ranges and determine reasonable domain and range values for given situations, both continuous and discrete.

Readiness Standard

Use, Identify, Determine

REASONABLE MATHEMATICAL DOMAINS AND RANGES

Including, but not limited to:

- Comparison of discrete and continuous domains
- Representations of domains and ranges with and without technology
  - Tables
  - Graphs, including situational
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Notation of domain and range
  - Lists of domain and range in sets (including $f(x)$ for y)
  - Verbal
    - Ex: Domain is all real numbers; domain is all real numbers greater than five.
    - Ex: Range is all real numbers less than zero; range is all real numbers.
  - Symbolic
    - Ex: domain (e.g., $x > 0$; $-3 < x < 4$; Ø; R)
    - Ex: range (e.g., $y \leq 0$; $-7 < y \leq 4$; $-5 < f(x) \leq 2$; Ø; R)
- Determination of scales for graphs and windows on graphing calculators using domain and range
- Contextual domain and range of real-world problem situation
- Comparison of the domain and range of the problem situation versus the domain and range of the representative mathematical function

TxCCRS:

- VII. Functions B1 – Understand and analyze features of a function.

- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.

A.2C

Interpret situations in terms of given graphs or creates situations that fit given graphs.

Supporting Standard

Use, Interpret, Create

SITUATIONS IN TERMS OF GIVEN GRAPHS

Including, but not limited to:

- Graphs that model one or more problem situations
- Situations that model both linear and nonlinear graphs
- Identification and comparison of attributes (e.g., intercepts, minimum/maximum, symmetry, increasing/decreasing, rate of change, etc.)
- Predictions, decisions, and judgments from situational graphs

TxCCRS:

- II. Algebraic Reasoning D1 – Interpret multiple representations of equations and relationships.
- II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.
- VII. Functions B2 – Algebraically construct and analyze new functions.

A.2D

Collect and organize data, make and interpret scatterplots (including recognizing positive, negative, or no correlation for data approximating linear situations), and model, predict, and make decisions and critical judgments in problem situations.

Readiness Standard

Use, Collect, Organize

DATA

Including, but not limited to:

- Data sets and real-world problem situations
- Data with and without the use of data collection technology (e.g., graphing calculators, CBR/CBL, and computers)
- Representations of data with and without technology

- Tables
- Graphs, including scatterplots
- Verbal descriptions
- Algebraic generalizations (including equation and function notation)

Make, Interpret

SCATTERPLOTS AND REPRESENTATIVE FUNCTIONS FOR DATA

Including, but not limited to:

- Data sets and real-world problem situations
- General trends in the data
- Data analysis with and without the use of technology (e.g., graphing calculators, CBR/CBL, and computers)
- Representations of data with and without technology
  - Tables
  - Graphs, including scatterplots
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Linear or nonlinear scatterplots using graphing technology
  - Positive linear correlation
  - Negative linear correlation
  - No linear correlation

Make, Model, Predict

DECISIONS AND CRITICAL JUDGMENTS IN PROBLEM SITUATIONS

Including, but not limited to:

- Data sets and real-world problem situations
- General trends in the data with and without technology
- Data with and without the use of data collection technology (e.g., graphing calculators, CBR/CBL, and computers)
- Representations of data with and without technology
  - Tables
  - Graphs, including scatterplots
  - Verbal descriptions
  - Algebraic representations (including equation and function notation)

- Linear or nonlinear scatterplots using graphing technology
  - Positive linear correlation
  - Negative linear correlation
  - No linear correlation
- Predictions and critical judgments in terms of the scatterplots and representative functions

TxCCRS:

- II. Algebraic Reasoning D1 – Interpret multiple representations of equations and relationships.
- II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.
- III. Geometric Reasoning C2 – Make connections between geometry, statistics, and probability.
- IV. Measurement Reasoning D1 – Compute and use measures of center and spread to describe data.
- VI. Statistical Reasoning A1 – Plan a study.
- VI. Statistical Reasoning B1 – Determine types of data.
- VI. Statistical Reasoning B2 – Select and apply appropriate visual representations of data.
- VI. Statistical Reasoning B4 – Describe patterns and departure from patterns in a set of data.
- VI. Statistical Reasoning C1 – Make predictions and draw inferences using summary statistics.
- VI. Statistical Reasoning C2 – Analyze data sets using graphs and summary statistics.
- VI. Statistical Reasoning C3 – Analyze relationships between paired data using spreadsheets, graphing calculators, or statistical software.
- VII. Functions A2 – Recognize and distinguish between different types of functions.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C1 – Apply known function models.
- VII. Functions C2 – Develop a function to model a situation.
- VIII. Problem Solving and Reasoning B2 – Use various types of reasoning.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.
- IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
- IX. Communication and Representation C1– Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.3	***Foundations for functions. The student understands how algebra can be used to express generalizations and recognizes and uses the power of symbols to represent situations. The student is expected to:***

A.3A

Use symbols to represent unknowns and variables.

Supporting Standard

Use

SYMBOLS

Including, but not limited to:

- Representation of an unknown quantity in a problem situation
- Representation of a quantity that “varies” in a data table process column
- Representations of patterns in data collections
- Representations of data collections or problem situations with and without technology
  - Models
    - Pictorial (e.g., diagrams of the problem situation)
  - Verbal descriptions
  - Algebraic generalizations
- Verbal expressions translated to algebraic expressions using symbols
- Problem situation as an expression, equation, or inequality

Express, Represent

UNKNOWNS AND VARIABLES

Including, but not limited to:

- Representation of an unknown quantity in a problem situation
- Representation of a quantity that “varies” in a data table process column
- Representations of data collections or problem situations with and without technology
  - Models
    - Pictorial (e.g., diagrams of the problem situation)
  - Verbal descriptions
  - Algebraic generalizations
- Verbal expressions translated to algebraic expressions using symbols
- Problem situation as an expression, equation, or inequality

Note(s):

- In middle school, students use symbols to represent arithmetic sequences.
- TxCCRS:
  - VII. Functions B2 – Algebraically construct and analyze new functions.
  - VII. Functions C2 – Develop a function to model a situation.
  - IX. Communication and Representation A1 – Use mathematical symbols, terminology, and notation to represent given and unknown information in a problem.
  - IX. Communication and Representation A3 – Use mathematics as a language for reasoning, problem solving, making connections, and generalizing.

A.3B

Look for patterns and represent generalizations algebraically.

Supporting Standard

Understand, Use, Express, Recognize, Represent

PATTERNS AS ALGEBRAIC GENERALIZATIONS

Including, but not limited to:

- Hands-on data collection activities
- Problem situations with data collection
- Representations of patterns in data collections or problem situations with and without technology
  - Models
    - Concrete
    - Pictorial (e.g., diagrams of a problem situation)
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
  - Algebraic generalizations connected to relationships in patterns

Note(s):

- In middle school, students represent arithmetic sequences algebraically.
- In geometry, students will represent numeric and geometric patterns to develop algebraic expressions.
- TxCCRS:
  - VII. Functions B2 – Algebraically construct and analyze new functions.
  - VII. Functions C2 – Develop a function to model a situation.

A.4	***Foundations for functions. The student understands the importance of the skills required to manipulate symbols in order to solve problems and uses the necessary algebraic skills required to simplify algebraic expressions and solve equations and inequalities in problem situations. The student is expected to:***
A.4A	**Find specific function values, simplify polynomial expressions, transform and solve equations, and factor as necessary in problem situations.** ***Readiness Standard***

Find

FUNCTION VALUES

Including, but not limited to:

- Evaluation of mathematical expressions
  - Simplification of numeric expressions by order of operations
  - Evaluation of algebraic expressions when given specific values for variables
- Evaluation of functions
  - Equation notation
    - Ex: If (2, *y*) is a solution to the equation, find *y* if 2*x* – 3*y* = 7.
    - Ex: Given the equation *y* = 2*x* + 3 where *y* is dependent on *x*, what are the dependent values if *x* Î {-4, 0, 2, 12}?
  - Function notation
    - Ex: If *f(x)* = 2*x* – 1, find *f*(2).
    - Ex: If *f(x)* = 2*x* – 1 and *f(x)* = 5, find *x.*
- Function values using technology (e.g., the table or trace features on the graphing calculator)
- Specific range values at given domains from various representations (e.g., tables, graphs, or algebraic generalizations)
- Specific domain values at given ranges from various representations (e.g., tables, graphs, or algebraic generalizations)

Manipulate, Factor, Simplify, Use

POLYNOMIAL EXPRESSIONS

Including, but not limited to:

- Concrete and pictorial models of polynomials (e.g., algebra tiles, etc.)
- Characteristics of polynomials

- Classifications of polynomials
  - Monomial
  - Binomial
  - Trinomial
- Operations with polynomials (addition, subtraction, multiplication)
- Factoring polynomials
  - Greatest common factor
  - Difference of squares
  - Trinomials
- Algebraic generalization of a data set or problem situation
- Problem situations involving simplifying polynomials and operations with polynomials

Manipulate, Solve, Transform

EQUATIONS AND INEQUALITIES

Including, but not limited to:

- Distinction between expressions and equations and the difference between simplifying and solving (TxCCRS)
- Types of equations and inequalities
  - Linear
  - Quadratic
- Transformation of equations and inequalities using properties of equality and/or properties of inequalities
- Quadratic equations that may or may not require factorization

Note(s):

- In middle school, students solve equations in one variable using concrete models, pictorial models, and algebraic symbols.
- Algebra 1 introduces solving inequalities.
- TxCCRS:
  - I. Numeric Reasoning B1 – Perform computations with real and complex numbers. (Algebra 1 only requires the students to compute with real numbers.)
  - II. Algebraic Reasoning A1 – Explain and differentiate between expressions and equations using words such as “solve”, “evaluate”, and “simplify”.
  - II. Algebraic Reasoning B1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to combine, transform, and evaluate expressions (e.g., polynomials, radicals, rational expressions).
  - II. Algebraic Reasoning C1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to solve

equations, inequalities, and systems of linear equations.

A.4B

Use the commutative, associative, and distributive properties to simplify algebraic expressions.

Supporting Standard

Manipulate, Use

ALGEBRAIC PROPERTIES

Including, but not limited to:

- Commutative, associative, and distributive properties
- Simplification of algebraic expressions
- Transformations to solve equations and inequalities
- Problem situations including those involving perimeter, area, and composite figures

Simplify

ALGEBRAIC EXPRESSIONS

Including, but not limited to:

- Commutative, associative, and distributive properties
- Transformations to solve equations and inequalities
- Problem situations including those involving perimeter, area, and composite figures

Note(s):

- This does not mean identifying properties by name only.
- TxCCRS:
  - II. Algebraic Reasoning A1 – Explain and differentiate between expressions and equations using words such as “solve”, “evaluate”, and “simplify”.
  - II. Algebraic Reasoning B1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to combine, transform, and evaluate expressions (e.g., polynomials, radicals, rational expressions).
  - II. Algebraic Reasoning C1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to solve equations, inequalities, and systems of linear equations.

A.4C **Connect equation notation with function notation, such as y = x + 1 and f(x) = x + 1.**

Supporting Standard

Use, Connect

FUNCTION NOTATION

Including, but not limited to:

- Comparison of characteristics of equation notation and function notation
  - Domain of each type of notation is *x*.
  - Range of equation notation is *y*; range of function notation is *f*(*x*).
- Benefits of function notation
  - Function aligned to specific situation by descriptive letter (e.g., cost function as $C(x) = 30x + 100$)
  - Indication of domain input to evaluate in the function (e.g., $C(2) = 30(2) + 100$)

Note(s):

- Finding function values using function notation is addressed and has been tested under TEKS A.4A.
- TxCCRS:
  - VII. Functions B1 – Understand and analyze features of a function.

A.5 ***Linear functions. The student understands that linear functions can be represented in different ways and translates among their various representations. The student is expected to:***

A.5A **Determine whether or not given situations can be represented by linear functions.**

Supporting Standard

Represent, Determine

LINEAR FUNCTIONS FOR PROBLEM SITUATIONS

Including, but not limited to:

- Identification of a set of data as linear or nonlinear with and without technology
- Identification of a problem situation as linear or nonlinear
- Representations of data collections or problem situations with and without technology
  - Models

- Concrete
- Pictorial
- Tables
- Verbal descriptions
- Graphs
- Algebraic generalizations (including equation and function notation)

- Connections between representations with and without technology
- Justification for linearity (constant rate of change) as seen in representations

TxCCRS:

- VI. Statistical Reasoning B1 – Determine types of data.
- VII. Functions A1 – Recognize whether a relation is a function.
- VII. Functions A2 – Recognize and distinguish between different types of functions.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C1 – Apply known function models.
- VII. Functions C2 – Develop a function to model a situation.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.

A.5B

Determine the domain and range for linear functions in given situations.

Supporting Standard

Represent, Determine

DOMAIN AND RANGE FOR LINEAR FUNCTIONS

Including, but not limited to:

- Data collections involving linear functions with and without technology
- Problem situations involving linear functions
- Comparison of discrete and continuous domains
- Representations of domains and ranges with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Notation of domain and range

- Lists of domain and range in sets (including $f(x)$ for y)
- Verbal
  - Ex: Domain is all real numbers; domain is all real numbers greater than five.
  - Ex: Range is all real numbers less than zero; range is all real numbers.
- Symbolic
  - Ex: domain (e.g., $x > 0$; $-3 < x < 4$; Ø; R)
  - Ex: range (e.g., $y \leq 0$; $-7 < y \leq 4$; $-5 < f(x) \leq 2$; Ø; R)

- Determination of scales for graphs and windows on graphing calculators using domain and range
- Contextual domain and range of real-world problem situation
- Comparison of the domain and range of the problem situation versus the domain and range of the representative mathematical function

TxCCRS:

- VII. Functions B1 – Understand and analyze features of a function.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.

A.5C

Use, translate, and make connections among algebraic, tabular, graphical, or verbal descriptions of linear functions.

Readiness Standard

Represent, Translate, Use, Make

CONNECTIONS AMONG REPRESENTATIONS OF LINEAR FUNCTIONS

Including, but not limited to:

- Data sets involving linear functions with and without technology
- Problem situations involving linear functions
- Representations of linear functions with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Connections and translations between various representations of linear functions with and without technology

TxCCRS:

- II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.
- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VI. Statistical Reasoning B2 – Select and apply appropriate visual representations of data.
- VII. Functions A1 – Recognize whether a relation is a function.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C2 – Develop a function to model a situation.
- IX. Communication and Representation A3 – Use mathematics as a language for reasoning, problem solving, making connections, and generalizing.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.
- IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
- IX. Communication and Representation C1– Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6 ***Linear functions. The student understands the meaning of the slope and intercepts of the graphs of linear functions and zeros of linear functions and interprets and describes the effects of changes in parameters of linear functions in real-world and mathematical situations. The student is expected to:***

A.6A **Develop the concept of slope as rate of change and determine slopes from graphs, tables, and algebraic representations.**

Supporting Standard

Describe, Develop, Determine, Understand

SLOPE AS A RATE OF CHANGE

Including, but not limited to:

- Concept of slope as a rate of change
- Value of slope (rate of change)
- Slope (rate of change) from representations with and without technology
  - Tables

- Graphs, including scatterplots
- Algebraic generalizations

- Slope given two points
  - Table method by analyzing rate of change in *x* and *y* values: $m = \frac{\Delta y}{\Delta x}$
  - Formula method: $m = \frac{y_2 - y_1}{x_2 - x_1}$
- Slope in special cases
  - Horizontal lines, $m = 0$
  - Vertical lines, m is undefined
- Connections of slope between representations

Note(s):

- In middle school, tables and symbols are used to represent relationships with constant rate of change.
- TxCCRS:
  - III. Geometric Reasoning C1 – Make connections between geometry and algebra.
  - VII. Functions B1 – Understand and analyze features of a function.
  - IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.
  - IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
  - X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6B

Interpret the meaning of slope and intercepts in situations using data, symbolic representations, or graphs.
Readiness Standard

Interpret, Understand

MEANING OF SLOPE AND INTERCEPTS

Including, but not limited to:

- Representations of slope and intercepts (*x*-intercept and *y*-intercept) with and without technology
  - Tables

- Graphs, including scatterplots
- Verbal descriptions
- Algebraic generalizations

- Connections and translation among the different representations with and without technology
- Real-world problem situations
- Slope as the rate of change in the context of a problem situation
- Emphasis on units of slope in relation to the problem situation (e.g., miles per hour, kilowatts per hour, ounces per gallon, etc.)
- Intercepts in the context of a problem situation
- Emphasis on units of intercepts in relation to the problem situation
  - *y*-intercept
    - Ex: (0, 2): When Mary left school at an elapsed time of 0 minutes, she was 2 miles from home.
  - *x*-intercept
    - Ex: (40, 0): After an elapsed time of 40 minutes, Mary arrived at home.

TxCCRS:

- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- IX. Communication and Representation A2 – Use mathematical language to represent and communicate the mathematical concepts in a problem.
- IX. Communication and Representation A3 – Use mathematics as a language for reasoning, problem solving, making connections, and generalizing.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6C

Investigate, describe, and predict the effects of changes in m and b on the graph of y = mx + b.

Readiness Standard

Interpret, Describe, Investigate, Predict, Understand

EFFECTS OF LINEAR PARAMETER CHANGES

Including, but not limited to:

- Linear parent function ($y = x$)
- Representations of linear functions and related transformed functions with and without technology

- Graphs
- Verbal descriptions
- Algebraic generalizations (including equation and function notation)

- Connections among the representations with and without technology
- Effects of changing m on $y = mx + b$ using various representations with and without technology
  - $|m| > 1$, graph stretches vertically (steeper)
  - $0 < |m| < 1$, graph compresses vertically (flatter)
  - Positive values of m, graph rises from left to right (increasing)
  - Negative values of m, graph falls from left to right (decreasing)
- Effects of changing b on $y = mx + b$ using various representations with and without technology
  - $b = 0$, passes through the origin
  - $b > 0$, vertical shift up by $|b|$ units
  - $b < 0$, vertical shift down by $|b|$ units
- Representation of a verbal description of a change using a graph, table, and/or algebraic generalization
- Comparison of original function and the translated function
  - Use of function notation (e.g., $f(x)$ and $g(x)$) to represent original and translated functions

TxCCRS:

- III. Geometric Reasoning B1 – Identify and apply transformations to figures.
- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C1 – Apply known function models.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6D

Graph and write equations of lines given characteristics such as two points, a point and a slope, or a slope and y-intercept.

Supporting Standard

Graph, Write

EQUATIONS OF LINES

Including, but not limited to:

- Representations of data with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Connections among the representations with and without technology
- Equations of lines and their graphs given (including equation and function notation)
  - Two points
  - A point and slope
  - Slope and *y*-intercept
  - *y*-intercept and a point
- Forms of equations of lines
  - Slope-intercept form:
  - Point-slope form:
  - Standard form:
- Real–world problem situations

Note(s):

- In middle school, students must find algebraic expressions to represent specific relationships involving a constant rate of change.
- TxCCRS:
  - III. Geometric Reasoning C1 – Make connections between geometry and algebra.
  - VII. Functions B1 – Understand and analyze features of a function.
  - VII. Functions B2 – Algebraically construct and analyze new functions.
  - VII. Functions C2 – Develop a function to model a situation.
  - X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6E

Determine the intercepts of the graphs of linear functions and zeros of linear functions from graphs, tables, and algebraic representations.

Supporting Standard

Interpret, Describe, Determine

INTERCEPTS AND ZEROS OF LINEAR FUNCTIONS

Including, but not limited to:

- *y*-intercepts of linear functions, (0, *y*)
- *x*-intercepts/zeros of linear functions, (*x*, 0)
- *x*- and *y*-intercepts from representations with and without technology
  - Tables
  - Graphs
  - Algebraic generalizations (including equation and function notation)
    - *y*-intercept: substitute 0 for *x,* and solve for *y*
    - *x*-intercept: substitute 0 for *y,* and solve for *x*
- Comparison of *x*-intercepts and zeros of functions
- Intercepts in real-world problem situations

TxCCRS:

- III. Geometric Reasoning B1 – Identify and apply transformations to figures.
- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C1 – Apply known function models.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6F

Interpret and predict the effects of changing slope and y-intercept in applied situations.

Readiness Standard

Interpret, Describe, Determine, Predict

EFFECTS OF CHANGING SLOPE AND INTERCEPTS IN APPLIED SITUATIONS

Including, but not limited to:

- Data collections and problem situations
- Effects on changing slope and y-intercept on representations of data with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations

- Effects of change in slope and/or *y*-intercept in the problem situation
- Connections between effects of changes in slope and/or *y*-intercept on the representative linear function and changes in the problem situation

TxCCRS:

- III. Geometric Reasoning B1 – Identify and apply transformations to figures.
- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.6G

Relate direct variation to linear functions and solve problems involving proportional change.

Supporting Standard

Interpret, Describe, Relate

DIRECT VARIATION AS A LINEAR FUNCTION

Including, but not limited to:

- Comparison of characteristics of direct variation (proportional change) and linear functions
  - Linearity
  - *y*-intercept of (0, 0) versus (0, *b*)
  - Constant of proportionality, $k = \frac{y}{x}$ versus slope, $m = \frac{\Delta y}{\Delta x}$
  - Algebraic generalization, $y = kx$ versus $y = mx + b$
- Representations of direct variation with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
    - Ex: *y* varies directly with *x*.
    - Ex: *y* is directly proportional to *x*.
  - Algebraic generalizations

Solve

PROBLEMS INVOLVING PROPORTIONAL CHANGE

Including, but not limited to:

- Problem situations involving proportional change (direct variation)
  - Ratio comparison problems (e.g., $d = rt$, unit conversions, unit rates, etc.)
  - y varies directly with x problems.
  - y is directly proportional to x problems.
- Methods for solving proportional situations
  - Emphasis on units in the problem situation
  - Setting up problem as a proportion
  - Scale factors and equivalent ratios
  - Cross products
  - Algebraic generalizations
- Significance of the y-intercept, (0, 0), in direct variation situations

Note(s):

- In middle school, students compare and contrast proportional and non-proportional linear relationships.
- TxCCRS:
  - VII. Functions B1 – Understand and analyze features of a function.
  - VII. Functions C2 – Develop a function to model a situation.
  - VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.

A.7	***Linear functions. The student formulates equations and inequalities based on linear functions, uses a variety of methods to solve them, and analyzes the solutions in terms of the situation. The student is expected to:***
A.7A	**Analyze situations involving linear functions and formulate linear equations or inequalities to solve problems.** ***Supporting Standard***

Use, Analyze, Formulate, Solve

EQUATIONS AND INEQUALITIES FOR PROBLEM SITUATIONS

Including, but not limited to:

- Linear equations and inequalities representing data collections and problem situations
- Representations of data sets and problem situations

- Tables
- Graphs
- Verbal descriptions
- Algebraic generalizations

- Connections between the representations and the representative linear equation or inequality
- Appropriate use of equality and inequality symbols: (=, >, <, ≥, ≤)

Note(s):

- In middle school, students solve equations using concrete models, pictorial models, and algebraic symbols.
- TxCCRS:
  - VII. Functions C2 – Develop a function to model a situation.
  - IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.

A.7B

Investigate methods for solving linear equations and inequalities using concrete models, graphs, and the properties of equality, select a method, and solve the equations and inequalities.

Readiness Standard

Use, Investigate, Select

METHODS FOR SOLVING EQUATIONS AND INEQUALITIES

Including, but not limited to:

- Concrete and pictorial models (e.g., algebra tiles, etc.)
- Graphs with and without technology
- Tables with and without technology
- Transformations using the properties of equality and/or inequality
- Relationships and connections between the methods of solution
- Distinction between expressions and equations and the difference between simplifying and solving (TxCCRS)

Solve

EQUATIONS AND INEQUALITIES

Including, but not limited to:

- Equations or inequalities that represent a problem situation or data collection
- Missing coordinate of a solution point to a function
  - Ex: If (x, -4) is a solution to the equation $5y - 4x = -8$, what is the value of x?
- Appropriate methods for solving particular linear equations or inequalities
  - Concrete models (e.g., algebra tiles, etc.)
  - Graphs with and without technology
  - Tables with and without technology
  - Transformations using the properties of equality and/or inequality
- Relationships and connections between the methods of solution
- Comparison of solution sets of equations and inequalities (TxCCRS)
  - Equations
    - One-dimensional
      - Ex: $x = 2$ and a point on a number line
      - Two-dimensional
        - Ex: $y = 2x + 3$ or $f(x) = 2x + 3$ and a solid line on a coordinate plane
        - Ex: $y = 2$ and a horizontal solid line on a coordinate plane
        - Ex: $x = 2$ and a vertical solid line on a coordinate plane
  - Inequalities
    - One-dimensional
      - Ex: $x < 2$ and a number line with an open circle at 2 shaded to the left of 2
      - Two-dimensional
        - Ex: $y > 2x + 3$ and a dotted line with shading above on a coordinate plane
        - Ex: $y \leq 2x + 3$ and a solid line with shading below on a coordinate plane
        - Ex: $y \leq 2$ and a solid horizontal line with shading below on a coordinate plane
        - Ex: $x \geq 2$ and a solid vertical line shaded to the right on a coordinate plane
- Distinction between expressions and equations and the difference between simplifying and solving (TxCCRS)

Note(s):

- In middle school, students solve equations using concrete models, pictorial models, and algebraic symbols.
- TxCCRS:
  - II. Algebraic Reasoning A1 – Explain and differentiate between expressions and equations using words such as “solve”, “evaluate”, and “simplify”.
  - II. Algebraic Reasoning C1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to solve

equations, inequalities, and systems of linear equations.

- II. Algebraic Reasoning C2 – Explain the difference between the solution set of an equation and the solution set of an inequality.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.

A.7C

Interpret and determine the reasonableness of solutions to linear equations and inequalities.

Supporting Standard

Analyze, Interpret, Determine

REASONABLENESS OF SOLUTIONS TO EQUATIONS AND INEQUALITIES

Including, but not limited to:

- Justification of solutions to equations with and without technology
  - Verbal
  - Graphical
  - Algebraic by substitution of solutions into original function
- Justification of solutions to inequalities with and without technology
  - Verbal
  - Numerically on a number line
  - Graphical
  - Algebraic by substitution of solutions into original function
- Justification of reasonableness of solution in terms of the problem situation or data collection

Note(s):

- In middle school, students solve equations using concrete models, pictorial models, and algebraic symbols.
- TxCCRS:
  - I. Numeric Reasoning C1 – Use estimation to check for errors and reasonableness of solutions.

A.8

Linear functions. The student formulates systems of linear equations from problem situations, uses a variety of methods to solve them, and analyzes the solutions in terms of the situation. The student is expected to:

A.8A

Analyze situations and formulate systems of linear equations in two unknowns to solve problems.

Supporting Standard

Analyze, Formulate, Use, Solve

SYSTEMS OF EQUATIONS FOR PROBLEM SITUATIONS

Including, but not limited to:

- Problem situations represented by 2 x 2 systems of linear equations
  - Two unknowns
  - Two equations

TxCCRS:

- VII. Functions C2 – Develop a function to model a situation.
- IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.

A.8B

Solve systems of linear equations using concrete models, graphs, tables, and algebraic methods.

Readiness Standard

Use, Solve

SYSTEMS OF EQUATIONS

Including, but not limited to:

- Distinction between expressions and equations and the difference between simplifying and solving (TxCCRS)
- 2 x 2 systems of equations to represent problem situations
- Methods for solving linear 2 x 2 system of equations with and without technology
  - Concrete and pictorial models
  - Tables
    - Common points on tables
  - Graphs
    - Identification of possible solutions in terms of points of intersection
  - Algebraic methods
    - Substitution

- Linear combinations (elimination)
- Relationships and connections between the methods of solution
- Representation of the solution as a point of intersection
- Interpretation of the point of intersection in terms of the problem situation

TxCCRS:

- II. Algebraic Reasoning A1 – Explain and differentiate between expressions and equations using words such as “solve”, “evaluate”, and “simplify”.
- II. Algebraic Reasoning C1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to solve equations, inequalities, and systems of linear equations.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.

A.8C

Interpret and determine the reasonableness of solutions to systems of linear equations.

Supporting Standard

Analyze, Interpret, Determine

REASONABLENESS OF SOLUTIONS TO SYSTEMS OF EQUATIONS

Including, but not limited to:

- Justification of solutions to systems of equations with and without technology
  - Tables
  - Graphs
  - Verbal description
  - Substitution of solutions into original function
- Justification of reasonableness of solution in terms of the problem situation or data collection

TxCCRS:

- I. Numeric Reasoning C1 – Use estimation to check for errors and reasonableness of solutions.

A.9

Quadratic and other nonlinear functions. The student understands that the graphs of quadratic functions are affected by the parameters of the function and can interpret and describe the effects of changes in the parameters of quadratic

functions. The student is expected to:

A.9A

Determine the domain and range for quadratic functions in given situations.

Supporting Standard

Determine

DOMAIN AND RANGE OF QUADRATIC FUNCTIONS

Including, but not limited to:

- Data collections involving quadratic functions with and without technology
- Problem situations involving quadratic functions
- Comparison of discrete and continuous domains
- Representations of domains and ranges with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Notation of domain and range
  - Lists of domain and range in sets (including $f(x)$ for y)
  - Verbal
    - Ex: Domain is all real numbers; domain is all real numbers greater than five.
    - Ex: Range is all real numbers less than zero; range is all real numbers.
  - Symbolic
    - Ex: domain (e.g., $x > 0$; $-3 < x < 4$; Ø; R)
    - Ex: range (e.g., $y \leq 0$; $-7 < y \leq 4$; $-5 < f(x) \leq 2$; Ø; R)
- Determination of scales for graphs and windows on graphing calculators using domain and range
- Contextual domain and range of real-world problem situation
- Comparison of the domain and range of the problem situation versus the domain and range of the representative mathematical function

TxCCRS:

- VII. Functions B1 – Understand and analyze features of a function.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.

A.9B

Investigate, describe, and predict the effects of changes in *a* on the graph of $y = ax^2 + c$.

Supporting Standard

Understand, Interpret, Investigate, Describe, Predict

EFFECTS OF CHANGES IN "*a*" ON QUADRATIC FUNCTIONS

Including, but not limited to:

- Quadratic parent function ($y = x^2$)
- Analysis of transformations on the quadratic parent function using various representations with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Connections among the representations with and without technology
- Effects of changing *a* on the graph of the quadratic parent function with and without technology
  - Dilation of the function
  - *a*0, or it would be a linear function
  - |*a*| >1, graph stretches vertically (narrows)
  - 0 < |*a*| < 1, graph compresses vertically (widens)
  - Opposite of *a* reflects the function over the horizontal axis (*x*-axis)
- Representation of a verbal description of a change using a graph, table, and/or algebraic generalization with and without technology
- Comparison of critical attributes of original function and the translated function with and without technology

TxCCRS:

- III. Geometric Reasoning B1 – Identify and apply transformations to figures.
- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C1 – Apply known function models.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.9C

Investigate, describe, and predict the effects of changes in *c* on the graph of $y = ax^2 + c$.

Supporting Standard

Understand, Interpret, Investigate, Describe, Predict

EFFECTS OF CHANGES IN "*c*" ON QUADRATIC FUNCTIONS

Including, but not limited to:

- Quadratic parent function ($y = x^2$)
- Analysis of transformations on the quadratic parent function using various representations with and without technology
  - Tables
  - Graphs
  - Verbal descriptions
  - Algebraic generalizations (including equation and function notation)
- Connections among the representations with and without technology
- Effects of changing *c* on the graph of the quadratic parent function with and without technology
  - Translation of the function
  - $c = 0$, vertex at the origin
  - $c > 0$, vertical shift up by $|c|$ units
  - $c < 0$, vertical shift down by $|c|$ units
- Representation of a verbal description of a change using a graph, table, and/or algebraic generalization with and without technology
- Comparison of original function and the translated function

TxCCRS:

- III. Geometric Reasoning B1 – Identify and apply transformations to figures.
- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C1 – Apply known function models.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.9D

Analyze graphs of quadratic functions and draw conclusions.

Readiness Standard

Understand, Interpret, Describe, Analyze

GRAPHS OF QUADRATIC FUNCTIONS

Including, but not limited to:

- Characteristics of quadratic functions with and without technology
  - Vertex (minimum or maximum)
    - Graphically
    - Algebraically $x = \frac{-b}{2a}$ and solving for y
  - Zeros (x-intercepts)
  - Axis of symmetry
  - Symmetric points
  - Graph orientation (positive, negative)
- Data from real-world situations involving a quadratic function using a variety of representations
- Analysis and conclusion about problem situations from a graph

Draw

CONCLUSIONS FROM GRAPHS OF QUADRATIC FUNCTIONS

Including, but not limited to:

- Characteristics of quadratic functions in terms of problem situations with and without technology
  - Vertex (minimum or maximum)
    - Graphically
    - Algebraically $x = \frac{-b}{2a}$ and solving for y
  - Zeros (x-intercepts)
  - Axis of symmetry
  - Symmetric points
  - Graph orientation (positive, negative)
- Real-world situations involving quadratic functions
- Analysis and conclusion about problem situations from a graph

TxCCRS:

- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions C1 – Apply known function models.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.10 ***Quadratic and other nonlinear functions. The student understands there is more than one way to solve a quadratic equation and solves them using appropriate methods. The student is expected to:***

A.10A **Solve quadratic equations using concrete models, tables, graphs, and algebraic methods.**
Readiness Standard

Solve

QUADRATIC EQUATIONS

Including, but not limited to:

- Analysis of quadratic data through tables and graphs with and without technology
- Distinction between expressions and equations and the difference between simplifying and solving (TxCCRS)
- Methods for solving quadratic functions with and without technology
  - Concrete and pictorial models (e.g., algebra tiles, etc.)
  - Tables
    - Zeros
  - Graphs
    - Zeros
    - *x*-intercepts
  - Algebraic methods
    - Factoring
    - Algebraic manipulation
    - Quadratic formula, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- Solution sets of quadratic equations
  - Two solutions
    - Ex: $x = -2$ and 5; {-2, 5}; $x = -2$ and $x = 5$; (-2, 0) and (5, 0)

- One solution
  - Ex: -2; {-2}; $x = -2$; (-2, 0) which is a double root
- No solution
  - Ex: no real roots

- Problem situation and/or data collection activity involving a quadratic function with and without technology
  - Quadratic equation to represent the problem situation
  - Method of choice to solve

TxCCRS:

- II. Algebraic Reasoning A1 – Explain and differentiate between expressions and equations using words such as “solve”, “evaluate”, and “simplify”.
- II. Algebraic Reasoning C1 – Recognize and use algebraic (field) properties, concepts, procedures, and algorithms to solve equations, inequalities, and systems of linear equations.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.

A.10B

Make connections among the solutions (roots) of quadratic equations, the zeros of their related functions, and the horizontal intercepts (x-intercepts) of the graph of the function.

Supporting Standard

Understand, Make

CONNECTIONS BETWEEN QUADRATIC FUNCTIONS AND QUADRATIC EQUATIONS

Including, but not limited to:

- Representations of quadratic functions
  - Graphs
  - Algebraic generalizations
- Comparisons of quadratic equations ($0 = ax^2 + bx + c$) and quadratic functions ($y = ax^2 + bx + c$)
- Association of solutions and roots to quadratic equations
- Association of zeros and horizontal intercepts (x-intercepts) to graphs of functions
- Connections between solutions and roots of quadratic equations to the zeros and x-intercepts of the related function

TxCCRS:

- III. Geometric Reasoning C1 – Make connections between geometry and algebra.
- VII. Functions B1 – Understand and analyze features of a function.
- VII. Functions C2 – Develop a function to model a situation.
- X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.11	***Quadratic and other nonlinear functions. The student understands there are situations modeled by functions that are neither linear nor quadratic and models the situations. The student is expected to:***
A.11A	**Use patterns to generate the laws of exponents and apply them in problem-solving situations.** ***Supporting Standard***

Understand, Use, Generate

LAWS OF EXPONENTS

Including, but not limited to:

- Pattern activities modeling laws of exponents
- Laws of exponents
  - Zero power
  - Negative exponents
  - Multiplication law of exponents
  - Division law of exponents
  - Power law of exponents

Use, Apply

LAWS OF EXPONENTS IN PROBLEM SITUATIONS

Including, but not limited to:

- Laws of exponents
  - Zero power
  - Negative exponents
  - Multiplication law of exponents
  - Division law of exponents
  - Power law of exponents

- Laws of exponents to simplify polynomial expressions
- Laws of exponents in problem situations and diagrams (e.g., perimeter, area, volume, etc.)

Note(s):

- In middle school, students write numbers in exponential form.
- TxCCRS:
  - III. Geometric Reasoning C1 – Make connections between geometry and algebra.
  - VII. Functions C1 – Apply known function models.
  - VII. Functions C2 – Develop a function to model a situation.
  - X. Connections A1 – Connect and use multiple strands of mathematics in situations and problems.

A.11B

Analyze data and represent situations involving inverse variation using concrete models, tables, graphs, or algebraic methods.

Supporting Standard

Understand, Model, Analyze, Represent

INVERSE VARIATION

Including, but not limited to:

- Problem situation and/or data sets involving inverse relationships with and without technology
- Representations of data with and without technology
  - Concrete models
  - Tables
  - Graphs
  - Algebraic generalizations (including equation and function notation)
- Analysis of representations of inverse variation with and without technology
- Reasonableness of solutions in terms of the situation

Note(s):

- In Algebra 2, students will extend the study of rational functions and equations.
- TxCCRS:
  - II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.
  - VII. Functions B1 – Understand and analyze features of a function.

- VII. Functions B2 – Algebraically construct and analyze new functions.
- VII. Functions C2 – Develop a function to model a situation.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.
- IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
- IX. Communication and Representation C1– Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.

A.11C

Analyze data and represent situations involving exponential growth and decay using concrete models, tables, graphs, or algebraic methods.

Supporting Standard

Understand, Model, Analyze, Represent

EXPONENTIAL GROWTH AND DECAY

Including, but not limited to:

- Problem situation and/or data sets involving exponential growth and decay with and without technology
- Representation of data with and without technology
  - Concrete models
  - Tables
  - Graphs
  - Algebraic generalizations (including equation and function notation)
- Analysis of representations of exponential growth and decay with and without technology
- Comparison between exponential growth and decay with and without technology
- Reasonableness of solutions in terms of the situation

Note(s):

- In Algebra 2, students will extend the study of exponential functions and equations.
- TxCCRS:
  - II. Algebraic Reasoning D2 – Translate among multiple representations of equations and relationships.
  - VII. Functions B1 – Understand and analyze features of a function.
  - VII. Functions B2 – Algebraically construct and analyze new functions.

- VII. Functions C2 – Develop a function to model a situation.
- VIII. Problem Solving and Reasoning C2 – Use a function to model a real world situation.
- IX. Communication and Representation B1 – Model and interpret mathematical ideas and concepts using multiple representations.
- IX. Communication and Representation B2 – Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
- IX. Communication and Representation C1– Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words.

Bold black text in italics: Knowledge and Skills Statement (TEKS); **Bold black text: Student Expectation (TEKS)**
Bold red text in italics: Student Expectation identified by TEA as a ***Readiness Standard*** for STAAR
Bold green text in italics: Student Expectation identified by TEA as a ***Supporting Standard*** for STAAR
Blue text: Supporting information / Clarifications from TCMPC (Specificity)
Black text: Texas Education Agency (TEA); Texas College and Career Readiness Standards (TxCCRS)