

Algebra, Functions, and Data Analysis *Standards of Learning* - 2023 Overview of Revisions

This overview includes a summary of the content embedded in two content strands.

Algebra and Functions

- Investigate, analyze, and compare linear, quadratic, and exponential function families, algebraically and graphically, using transformations
- Investigate and analyze characteristics of the graphs of linear, quadratic, exponential, and piecewise-defined functions
- Represent and interpret contextual situations with constraints that require optimization using linear programming techniques, including systems of linear equations or inequalities, solving graphically and when appropriate, algebraically

Data Analysis

- Apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on representing bivariate data in scatterplots and determining the curve of best fit using linear, quadratic, and exponential functions
- Apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on the design and implementation of an experiment and/or survey
- Calculate and interpret probabilities, including those arising from contextual situations
- Describe and apply the properties of normal distribution, including those that arise from contextual situations

Comparison of AFDA Mathematics *Standards of Learning* – 2016 to 2023

2016 <i>Standards of Learning</i> Essential Knowledge and Skills (EKS) Algebra and Functions	2023 <i>Standards of Learning</i> Knowledge and Skills (KS) Algebra and Functions (AF)
<p>AFDA.1 The student will investigate and analyze linear, quadratic, exponential, and logarithmic function families, and their characteristics. Key concepts include</p> <p>a) domain and range; b) intervals on which a function is increasing or decreasing; c) absolute maxima and minima; d) zeros; e) intercepts; f) values of a function for elements in its domain; g) connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs; h) end behavior; and i) vertical and horizontal asymptotes.</p> <ul style="list-style-type: none"> ● Identify the domain, range, zeros, and intercepts of a function presented algebraically or graphically. Domains may be limited by problem context or in graphical representations. (a, d, e) ● Identify intervals on which the function is increasing or decreasing. (b) ● Identify the location and value of the absolute maximum and absolute minimum of a function over the domain of the function graphically or by using a graphing utility. (c) ● For any x value in the domain of f, determine $f(x)$. (f) 	<p>AFDA.AF.2 The student will investigate and analyze characteristics of the graphs of linear, quadratic, exponential, and piecewise-defined functions.</p> <p>a) Determine the domain and range of a function given a graphical representation, including those limited by contexts. b) Identify intervals on a graph for which a function is increasing, decreasing, or constant. c) Given a graph, identify the location and value of the absolute maximum and absolute minimum of a function over the domain of a function. d) Given a graph, determine the zeros and intercepts of a function. e) Describe and recognize the connection between points on the graph and the value of a function. f) Describe the end behavior of a function given its graph. g) Identify horizontal and/or vertical asymptotes from the graph of a function, if they exist. h) Describe and relate the characteristics of the graphs of linear, quadratic, exponential, and piecewise-defined functions, including those in contextual situations.</p>

<p style="text-align: center;">2016 Standards of Learning Essential Knowledge and Skills (EKS) Algebra and Functions</p>	<p style="text-align: center;">2023 Standards of Learning Knowledge and Skills (KS) Algebra and Functions (AF)</p>
<ul style="list-style-type: none"> ● Represent relations and functions using verbal descriptions, tables, equations, and graphs. Given one representation, represent the relation in another form. (g) ● Detect patterns in data and represent arithmetic and geometric patterns algebraically. (g) ● Describe the end behavior of a function. (h) ● Determine the equations of the horizontal asymptote of an exponential function and the vertical asymptote of a logarithmic function. (i) ● Investigate and analyze characteristics and multiple representations of functions with a graphing utility. (a, b, c, d, e, f, g, h, i) 	
<p>AFDA.2 The student will use knowledge of transformations to write an equation, given the graph of a linear, quadratic, exponential, and logarithmic function.</p> <ul style="list-style-type: none"> ● Write an equation of a line when given the graph of a line. ● Recognize graphs of parent functions for linear, quadratic, exponential and logarithmic functions. ● Write the equation of a linear, quadratic, exponential, or logarithmic function in vertex form, given the graph of the parent function and transformation information. ● Describe the transformation from the parent function given the equation written in vertex form or the graph of the function. ● Given the equation of a function, recognize the parent function and transformation to graph the given function. 	<p>AFDA.AF.1 The student will investigate, analyze, and compare linear, quadratic, and exponential function families, algebraically and graphically, using transformations.</p> <ol style="list-style-type: none"> a) Identify graphs and equations of parent functions for linear, quadratic, and exponential function families. b) Describe the transformation from the parent function given the equation or the graph of the function. c) Determine and analyze whether a linear, quadratic, or exponential function best models a given representation, including those in context. d) Write the equation of a linear, quadratic, or exponential function, given a graph, using transformations of the parent function. e) Use a graphical or algebraic representation of a function to solve problems within a context, graphically and algebraically, when appropriate.

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<ul style="list-style-type: none"> ● Recognize the vertex of a parabola given a quadratic equation in vertex form or graphed. ● Describe the parent function represented by a scatterplot. 	<ul style="list-style-type: none"> f) Graph a function given the equation of a function, using transformations of the parent function. Use technology to verify transformations of functions. g) Compare and contrast linear, quadratic, and exponential functions using multiple representations (e.g., graphs, tables, equations, verbal descriptions).
<p>AFDA.3 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems using models of linear, quadratic, and exponential functions.</p> <ul style="list-style-type: none"> ● Determine an equation for the curve of best fit, given a set of no more than 20 data points in a table, on a graph, or practical situation. ● Make predictions, using data, scatterplots, or the equation of the curve of best fit. ● Solve practical problems involving an equation of the curve of best fit. ● Evaluate the reasonableness of a mathematical model of a practical situation. 	<p>[Moved to AFDA.DA.1]</p>
<p>AFDA.4 The student will use multiple representations of functions for analysis, interpretation, and prediction.</p> <ul style="list-style-type: none"> ● Given an equation, graph a linear, quadratic, exponential or logarithmic function. ● Make predictions given a table of values, a graph, or an algebraic formula. 	<p>[Moved to AFDA.AF.1]</p>

<p style="text-align: center;">2016 Standards of Learning Essential Knowledge and Skills (EKS) Algebra and Functions</p>	<p style="text-align: center;">2023 Standards of Learning Knowledge and Skills (KS) Algebra and Functions (AF)</p>
<ul style="list-style-type: none"> ● Describe relationships between data represented in a table, in a scatterplot, and as elements of a function. ● Determine the appropriate representation of data derived from real-world situations. ● Analyze and interpret the data in context of the practical situation. ● Use a graphing utility to graph, analyze, interpret, and make predictions. 	
<p>AFDA.5 The student will determine optimal values in problem situations by identifying constraints and using linear programming techniques.</p> <ul style="list-style-type: none"> ● Model practical problems with systems of linear inequalities. ● Solve systems of no more than four linear inequalities with pencil and paper and using a graphing utility. ● Solve systems of no more than four equations algebraically and graphically. ● Identify the feasible region of a system of linear inequalities. ● Identify the coordinates of the vertices of a feasible region. ● Determine and describe the maximum or minimum value for the function defined over a feasible region. 	<p>AFDA.AF.3 The student will represent and interpret contextual situations with constraints that require optimization using linear programming techniques, including systems of linear equations or inequalities, solving graphically and when appropriate, algebraically.</p> <ol style="list-style-type: none"> a) Represent and interpret contextual problems requiring optimization with systems of linear equations or inequalities. b) Solve systems of no more than four equations or inequalities graphically and when appropriate, algebraically. c) Identify the feasible region of a system of linear inequalities. d) Identify the coordinates of the vertices of a feasible region. e) Determine and describe the maximum or minimum value for the function defined over a feasible region. f) Interpret the validity of possible solution(s) algebraically, graphically, using technology, and in context and justify the reasonableness of the answer(s) or the solution method in context.

<p align="center">2016 Standards of Learning Essential Knowledge and Skills (EKS) Data Analysis</p>	<p align="center">2023 Standards of Learning Knowledge and Skills (KS) Data Analysis (DA)</p>
<p>[Moved from AFDA.3]</p>	<p>AFDA.DA.1 The student will apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on representing bivariate data in scatterplots and determining the curve of best fit using linear, quadratic, and exponential functions.</p> <ul style="list-style-type: none"> a) Formulate investigative questions that require the collection or acquisition of bivariate data, where exactly two of the variables are quantitative. b) Collect or acquire bivariate data from a representative sample to answer an investigative question. c) Represent bivariate data with a scatterplot using technology and describe how the variables are related in terms of the given context. d) Make predictions, decisions, and critical judgments using data, scatterplots, or the equation(s) of the mathematical model.
<p>[Moved from AFDA.8]</p>	<p>AFDA.DA.2 The student will apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on the design and implementation of an experiment and/or observational study.</p> <ul style="list-style-type: none"> a) Formulate questions that can be addressed with data and assess the type of data relevant to the question (e.g., quantitative versus categorical). b) Investigate, describe, and determine best sampling techniques, such as simple random sampling, stratified sampling, and cluster sampling.

<p style="text-align: center;">2016 Standards of Learning Essential Knowledge and Skills (EKS) Data Analysis</p>	<p style="text-align: center;">2023 Standards of Learning Knowledge and Skills (KS) Data Analysis (DA)</p>
	<ul style="list-style-type: none"> c) Plan and conduct an experiment and/or observational study. The experimental design should address control, randomization, and minimization of experimental error. d) Collect or acquire data to answer a statistical question. e) Recognize that data may contain errors, have missing values, or may be biased, and make decisions about how to account for these issues. f) Identify biased sampling methods. g) Given a plan for an observational study, identify possible sources of bias, and describe ways to reduce bias. h) Select, create, and use appropriate visual representations of data to brainstorm solutions. i) Use appropriate statistical methods to analyze data. j) Communicate the description of an experiment and/or observational study, the resulting data, analysis, and the validity of the conclusions.
<p>AFDA.6 The student will calculate probabilities. Key concepts include</p> <ul style="list-style-type: none"> a) conditional probability; b) dependent and independent events; c) mutually exclusive events; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. <ul style="list-style-type: none"> • Analyze, interpret, and make predictions based on theoretical probability within practical context. (a, b, c, e) 	<p>AFDA.DA.3 The student will calculate and interpret probabilities, including those in contextual situations.</p> <ul style="list-style-type: none"> a) Analyze, interpret, and make predictions based on theoretical probability. b) Calculate conditional probabilities for dependent, independent, and mutually exclusive events. c) Represent and calculate probabilities using Venn diagrams, probability trees, organized lists, two-way tables, simulations, or other probability models.

<p style="text-align: center;">2016 Standards of Learning Essential Knowledge and Skills (EKS) Data Analysis</p>	<p style="text-align: center;">2023 Standards of Learning Knowledge and Skills (KS) Data Analysis (DA)</p>
<ul style="list-style-type: none"> ● Determine conditional probabilities for dependent, independent, and mutually exclusive events. (a, b, c) ● Represent and calculate probabilities using Venn diagrams and probability trees. (a) ● Define and give contextual examples of complementary, dependent, independent, and mutually exclusive events. (b, c) ● Given two or more events in a problem setting, determine whether the events are complementary, dependent, independent, and/or mutually exclusive. (b, c) ● Compare and contrast permutations and combinations, including those occurring in practical situations. (d) ● Calculate the number of permutations of n objects taken r at a time, without repetition. (d) ● Calculate the number of combinations of n objects taken r at a time, without repetition. (d) 	<ul style="list-style-type: none"> d) Interpret probabilities from simulations or experiments to make informed decisions and justify the rationale. e) Define and give contextual examples of complementary, dependent, independent, and mutually exclusive events. f) Given two or more events in a problem setting, determine whether the events are complementary, dependent, independent, and/or mutually exclusive. g) Compare and contrast permutations and combinations, including those in contextual situations. h) Calculate the number of permutations of n objects taken r at a time, without repetition. i) Calculate the number of combinations of n objects taken r at a time, without repetition.
<p>AFDA.7 The student will</p> <p>a) identify and describe properties of a normal distribution;</p> <p>b) interpret and compare z-scores for normally distributed data; and</p> <p>c) apply properties of normal distributions to determine probabilities associated with areas under the standard normal curve.</p> <ul style="list-style-type: none"> ● Identify the properties of a normal distribution. (a) ● Describe how the standard deviation and the mean affect the graph of the normal distribution. (a) ● Given standard deviation and mean, calculate, and interpret the 	<p>AFDA.DA.4 The student will describe and apply the properties of normal distribution, including those in contextual situations.</p> <ul style="list-style-type: none"> a) Identify and describe the properties of a normal distribution. b) Determine when the normal distribution is a reasonable representation of the data. c) Describe how the mean and the standard deviation affect the graph of the normal distribution. d) Calculate and interpret the z-score for a data point, given the mean and the standard deviation.

<p style="text-align: center;">2016 Standards of Learning Essential Knowledge and Skills (EKS) Data Analysis</p>	<p style="text-align: center;">2023 Standards of Learning Knowledge and Skills (KS) Data Analysis (DA)</p>
<ul style="list-style-type: none"> ● z-score for a data point. (b) ● Compare two sets of normally distributed data using a standard normal distribution and z-scores, given mean and standard deviation. (b) ● Represent probability as area under the curve of a standard normal distribution. (c) ● Use a graphing utility or a table of Standard Normal Probabilities to determine probabilities associated with areas under the standard normal curve. (c) ● Use a graphing utility to investigate, represent, and determine relationships between a normally distributed data set and its descriptive statistics. (a, b, c) 	<ul style="list-style-type: none"> e) Compare two sets of normally distributed data using a standard normal distribution and z-scores, given the mean and the standard deviation. f) Represent probability as the area under the curve of a standard normal distribution. g) Determine probabilities associated with areas under the standard normal curve, using technology or a table of Standard Normal Probabilities. h) Investigate, represent, and determine relationships between a normally distributed data set and its descriptive statistics.
<p>AFDA.8 The student will design and conduct an experiment/survey. Key concepts include</p> <ul style="list-style-type: none"> a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting. <ul style="list-style-type: none"> ● Investigate and describe sampling techniques, such as simple random sampling, stratified sampling, and cluster sampling. (a, b) ● Determine which sampling technique is best, given a particular context. (b) ● Identify biased sampling methods. (c) ● Given a plan for a survey, identify possible sources of bias, and describe ways to reduce bias. (c) 	<p>[Moved to AFDA.DA.2]</p>

<p style="text-align: center;">2016 <i>Standards of Learning</i> Essential Knowledge and Skills (EKS) Data Analysis</p>	<p style="text-align: center;">2023 <i>Standards of Learning</i> Knowledge and Skills (KS) Data Analysis (DA)</p>
<ul style="list-style-type: none"> ● Plan and conduct an experiment or survey. The experimental design should address control, randomization, and minimization of experimental error. (a, b, c, d) ● Compare and contrast controlled experiments, observational studies, and the conclusions one may draw from each. (e) ● Write a report describing the experiment/survey and the resulting data and analysis. (e) 	

2023 Algebra, Functions, and Data Analysis (AFDA) Mathematics SOL – Summary of Changes

AFDA (2016 SOL to 2023 SOL Numbering)	Parameter Changes/Clarifications (2023 SOL)
<ul style="list-style-type: none"> ● AFDA.1a-i → AFDA.AF.2 ● AFDA.2 → AFDA.AF.1 ● AFDA.3 → AFDA.DA.1 ● AFDA.4 → AFDA.AF.1 ● AFDA.5 → AFDA.AF.3 ● AFDA.6a-e → AFDA.DA.3 ● AFDA.7a-c → AFDA.DA.4 ● AFDA.8a-e → AFDA.DA.2 	<ul style="list-style-type: none"> ● AFDA.DA.1 - Removed the limitation of “no more than 20 data points to determine the curve of best fit” to allow for the analysis of larger data sets ● AFDA.DA.1 - Includes the use of a data cycle to formulate and investigate questions about bivariate data with scatterplots and using mathematical models ● AFDA.DA.2 - Includes the use of a data cycle to formulate and investigate questions and design surveys and experiments

Deletions from AFDA (2016 SOL)	Additions to AFDA (2023 SOL)
<ul style="list-style-type: none"> ● AFDA.2 - Investigate and analyze logarithmic function families and their characteristics [Included in Algebra 2] ● AFDA.1 - Use knowledge of transformations to write an equation, given the graph of a logarithmic function [Included in Algebra 2] 	<ul style="list-style-type: none"> ● AFDA.AF.2 - Investigate and analyze the characteristics of piecewise-defined functions ● AFDA.DA.3 - Interpret probabilities from simulations or experiments to make informed decisions and justify the rationale

KEY: AF = Algebra and Functions; DA = Data Analysis; EKS = Essential Knowledge and Skills (2016); KS = Knowledge and Skills (2023); US = Understanding the Standard