

# Unit #8 Functions

Content Area: **Math**  
Course(s):  
Time Period:  
Length: **15 weeks**  
Status: **Published**

## State Mandated Topics Addressed in this Unit

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N/A	N/A

## Functions

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## Learning Objectives

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- Objective 1 - Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication, add, subtract, and multiply polynomials.
- Objective 10 - Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- Objective 11 - Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .
- Objective 12 - Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- Objective 13 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.★
- Objective 14 - Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function  $h(n)$  gives the number of person-hours it takes to assemble  $n$  engines in a factory, then the positive integers would be an appropriate domain for the function.★
- Objective 15 - Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★
- Objective 16 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ Graph linear and quadratic functions and show intercepts, maxima, and minima.

- Objective 17 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- Objective 18 - Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
- Objective 19 - Distinguish between situations that can be modeled with linear functions and with exponential functions. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
- Objective 2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- Objective 20 - Distinguish between situations that can be modeled with linear functions and with exponential functions. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- Objective 21 - Distinguish between situations that can be modeled with linear functions and with exponential functions. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- Objective 22 - Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- Objective 23 - Interpret the parameters in a linear or exponential function in terms of a context.
- Objective 24 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- Objective 25 - Define appropriate quantities for the purpose of descriptive modeling.
- Objective 26 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Objective 27 - Recognize the position of the variable (left or right side from the equal sign), and apply the inverse operation using addition or subtraction.
- Objective 27 - Recognize the position of the variable (left or right side from the equal sign), and apply the inverse operation using multiplication or division.
- Objective 3 - Represent constraints by equations or inequalities and by systems of equations and/or inequalities and interpret solutions as viable or nonviable options in a modeling context. For example, they represent inequalities describing nutritional and cost constraints on combinations of different foods.
- Objective 4 - Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane often forming a curve which could be a line.
- Objective 5 - Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression, such as terms, factors, and coefficients.
- Objective 6 - Interpret expressions that represent a quantity in terms of its context. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret  $P(1+r)^n$  as the product of  $P$  and a factor not depending on  $P$ .
- Objective 7 - Write a function that describes a relationship between two quantities. ★ Determine an explicit expression, a recursive process, or steps for calculation from a context.
- Objective 8 - Write a function that describes a relationship between two quantities.★ Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.
- Objective 9 - Write a function that describes a relationship between two quantities.★ (+) Compose functions. For example, if  $T(y)$  is the temperature in the atmosphere as a function of height, and  $h(t)$  is the height of a weather balloon as a function of time, then  $T(h(t))$  is the temperature at the location of the

weather balloon as a function of time.

- Solve two step equations

## Essential Skills

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- Essential Skill 1 - Understand polynomials are closed under addition, subtraction, and multiplication
- Essential Skill 10 - Interpret parts of expressions including terms, factors, and coefficients.
- Essential Skill 11 - Interpret expressions in terms of context.
- Essential Skill 12 - Interpret parts of an expression in context, such as terms, factors, and coefficients.
- Essential Skill 13 - Interpret complicated expressions by viewing its parts as a single entity.
- Essential Skill 14 - Write a function that describes a relationship between two quantities
- Essential Skill 15 - \*Determine an explicit expression, recursive process, or steps for calculations from a given context\*
- Essential Skill 16 - Write a function that describes a relationship between two quantities.
- Essential Skill 17 - Combine functions using arithmetic operations.
- Essential Skill 18 - Build a function by combining two functions and relate the resulting functions to a model.
- Essential Skill 19 - Compose functions.
- Essential Skill 2 - Create equation that represents relationships between quantities.
- Essential Skill 20 - Identify the effect on a graph of  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$
- Essential Skill 21 - Find the values of  $k$  given a graph
- Essential Skill 22 - Experiment with cases using technology
- Essential Skill 23 - Understand that a function has one member of the domain assigned to exactly one element of the range.
- Essential Skill 24 -  $F(x)$  denotes the output of  $f$  corresponding to the input of  $x$ .
- Essential Skill 25 - The graph of  $f$  is the graph of  $y=f(x)$
- Essential Skill 26 - Use function notation to evaluation functions for inputs in their domain.
- Essential Skill 27 - Interpret statements that use function notations in terms of context.
- Essential Skill 28 - Sketch a graph using the key features of a function.
- Essential Skill 29 - Interpret key features from a graph or a table of values.
- Essential Skill 3 - Graph equations on axes with labels and scales.
- Essential Skill 30 - Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
- Essential Skill 31 - Relate the domain of a function its graph.
- Essential Skill 32 - Relate the domain of a function to the quantitative relationship that it describes.
- Essential Skill 33 - Calculate the average rate of change of a function from a graph or a function on an interval.
- Essential Skill 34 - Interpret the average rate of change.
- Essential Skill 35 - Estimate the average rate of change from a graph.
- Essential Skill 36 - Graph linear and quadratic functions showing key features including intercepts,

maxima and minima.

- Essential Skill 37 - Graph polynomial functions by hand and using technology.
- Essential Skill 38 - Show key features including intercepts, maxima, minima, zeroes, end behavior.
- Essential Skill 39 - Identify zeroes using factorization.
- Essential Skill 4 - Create equation that represents relationships between quantities.
- Essential Skill 40 - Compare properties of two functions represented differently (algebraically, graphically, numerically, verbally).
- Essential Skill 41 - Distinguish between situations that can be modeled with linear and exponential functions.
- Essential Skill 42 - Prove that linear functions grow by equal differences over equal intervals.
- Essential Skill 43 - Prove that exponential functions grow by equal factors over equal intervals.
- Essential Skill 44 - Distinguish between situations that can be modeled with linear functions and with exponential functions.
- Essential Skill 45 - Recognize situations where one quantity changes at a constant rate relative to another.
- Essential Skill 46 - Distinguish between situations that can be modeled with linear and exponential functions.
- Essential Skill 47 - Recognize situations where a quantity grows or decays by a constant percent rate.
- Essential Skill 48 - Observe using graphs that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or a polynomial).
- Essential Skill 49 - Observe using tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or a polynomial.
- Essential Skill 5 - Graph equations on axes with labels and scales.
- Essential Skill 50 - Interpret the parameters of a linear or exponential functions in context.
- Essential Skill 51 - Apply scales to graphs, origin of graph and data displays.
- Essential Skill 52 - Use units to make sense of solutions.
- Essential Skill 53 - Apply scales to multi-step problems and formulas.
- Essential Skill 54 - Interpret units in formulas.
- Essential Skill 55 - Choose units in formulas.
- Essential Skill 56 - Define quantities for descriptive modeling problems. (Incorporate appropriate units).
- Essential Skill 57 - Choose limits on measurements when reporting quantities.
- Essential Skill 58 - Choose the level of accuracy.
- Essential Skill 59 - Describe the components of an algebraic expression.
- Essential Skill 6 - Create equation that represents relationships between quantities.
- Essential Skill 60 - Combine like terms.
- Essential Skill 61 - Perform operations with variables and algebraic expressions.
- Essential Skill 62 - Solve one-step equations
- Essential Skill 7 - Graph equations on axes with labels and scales.
- Essential Skill 8 - Understand that the graph of an equation in two variables is the set of all of its solutions plotted in the coordinate plane.
- Essential Skill 9 - Understand that the solution set to an equation in two variables often forms a curve (which could be a line).

- Solve two step equations

## Standards

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MATH.9-12.A.APR.A	<p>Perform arithmetic operations on polynomials</p> <p>Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.</p>
MATH.9-12.A.APR.A.1	<p>Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.</p>
MATH.9-12.F.BF.A.1.a	<p>Determine an explicit expression, a recursive process, or steps for calculation from a context.</p>
MATH.9-12.F.BF.A.1.b	<p>Combine standard function types using arithmetic operations.</p>
MATH.9-12.F.BF.A.1.c	<p>Compose functions.</p> <p>Determining an output value for a particular input involves evaluating an expression; finding inputs that yield a given output involves solving an equation. Questions about when two functions have the same value for the same input lead to equations, whose solutions can be visualized from the intersection of their graphs. Because functions describe relationships between quantities, they are frequently used in modeling. Sometimes functions are defined by a recursive process, which can be displayed effectively using a spreadsheet or other technology.</p>
MATH.9-12.N.Q.A.1	<p>Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p>
MATH.9-12.N.Q.A.2	<p>Define appropriate quantities for the purpose of descriptive modeling.</p>
MATH.9-12.F.BF.B.3	<p>Identify the effect on the graph of replacing <math>f(x)</math> by <math>f(x) + k</math>, <math>k f(x)</math>, <math>f(kx)</math>, and <math>f(x + k)</math> for specific values of <math>k</math> (both positive and negative); find the value of <math>k</math> given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.</p>
MATH.9-12.N.Q.A.3	<p>Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>
MATH.9-12.A.CED.A.2	<p>Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>
MATH.9-12.A.CED.A.3	<p>Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.</p>
MATH.9-12.F.IF	<p>Interpreting Functions</p>

MATH.9-12.F.IF.A	Understand the concept of a function and use function notation
MATH.9-12.F.IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If $f$ is a function and $x$ is an element of its domain, then $f(x)$ denotes the output of $f$ corresponding to the input $x$ . The graph of $f$ is the graph of the equation $y = f(x)$ .
MATH.9-12.F.IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
MATH.9-12.F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
MATH.9-12.F.IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MATH.9-12.F.IF.B.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
MATH.9-12.F.IF.C.7.a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MATH.9-12.F.IF.C.7.c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
MATH.9-12.A.REI.D.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
MATH.9-12.F.IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MATH.9-12.A.SSE.A.1.a	Interpret parts of an expression, such as terms, factors, and coefficients.
MATH.9-12.A.SSE.A.1.b	Interpret complicated expressions by viewing one or more of their parts as a single entity.
MATH.9-12.F.LE.A.1.a	Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
MATH.9-12.F.LE.A.1.b	Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
MATH.9-12.F.LE.A.1.c	Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
MATH.9-12.F.LE.A.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
MATH.9-12.F.LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.

## **Instructional Tasks/Activities**

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- Combine like terms: Interactive activity in Quizizz.
- Complete missing work, absent work, retake quiz
- Educational Games
- Evaluating algebraic expressions
- Ladder Activity
- Makeup quiz, makeup assignments, extra credit
- One and two step equations word problems
- Practice two step equations on the board

- Proportional relationships
- Quiz
- Quizizz activity
- Review combining like terms
- Review Midterm
- Solving problems on the board
- Translate phrases into mathematical equations.
- Translate phrases into mathematical expression.
- Worksheet - plotting points in the cartesian plane
- Worksheet - Understand discrete functions
- Worksheet - Understand domain and range
- Worksheet - Understand how to identify a function using vertical line test
- Worksheet on Algebraic expression (Recognize the variable terms and constants), group terms with the same variable or without variable.
- Worksheet on Algebraic expression (Use different color highlighters to identify variable terms and constants)
- Worksheet on Combine like terms: practice making circles the terms with the same variable
- Worksheet on Combine like terms: practice making circles the terms with the same variable (using two variables)
- Worksheet on Combine like terms: practice using the learning methods.
- Worksheet on Combine like terms: Use different color highlighters to identify variable terms and constants before combine them (using more than one variable)
- Worksheet on Combine like terms: Use different color highlighters to identify variable terms and constants before combine them (using one variable)
- Worksheet on distributive property
- Worksheet on distributive property practice using the box method. (negative numbers)
- Worksheet on distributive property practice using the box method. (positive numbers)
- Worksheet on exponents
- Worksheet on fractions, decimals, and percentage.
- Worksheet on Integers under addition, subtraction, multiplication and division
- Worksheet on inverse operation
- Worksheet on One -Step equations "find the error" and make corrections
- Worksheet on One -Step equations completing blank boxes
- Worksheet on One -Step equations using the questionnaire
- Worksheet on One-step equation - using additions and subtraction.
- Worksheet on One-step equation - using multiplication and division.
- Worksheet on order of operations
- Worksheet on Two-step equation - notes and examples
- Worksheet on Two-step equation - solving the questionnaire
- Worksheet on Two-step equation - using steps checklist
- Worksheets

## **Assessment Procedure**

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- Class discussion
- Classroom Total Participation Technique
- Classwork
- Compare/Contrast Journals
- DBQ
- Electronic Active Responders
- Essay
- Exit Ticket/Entrance Ticket/Do Now
- Identify the Error Problems
- Journal / Student Reflection
- Kahoot
- Other named in lesson
- Peer Review
- Performance
- Problem Correction
- Project
- Quiz
- Rubric
- Teacher Collected Data
- Teacher Observation
- Test
- Worksheet

## **Recommended Technology Activities**

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- Appropriate Content Specific Online Resource
- Appropriate Content Specific Online Resource
- Copy/Paste Content Specific Link Here
- Copy/Paste Content Specific Link Here
- Copy/Paste Content Specific Link Here
- Gimkit
- GoGuardian
- Google Classroom
- Google Docs
- Google Slides
- Google Slides
- Kahoot

- MagicSchool AI
- Other- Specified in Lesson
- Quiziz
- Screencastify

## **Accommodations & Modifications & Differentiation**

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Accommodations and Modifications should be used to meet individual needs. Their IEP and 504 plans should be used in addition to the following suggestions.

## **Gifted and Talented**

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- Compare & Contrast
- Conferencing
- Debates
- Jigsaw
- Peer Partner Learning
- Problem Solving
- Structured Controversy
- Think, Pair, Share
- Tutorial Groups

## **Instruction/Materials**

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- alter format of materials (type/highlight, etc.)
- color code materials
- eliminate answers
- extended time
- extended time
- large print
- modified quiz
- modified test
- Modify Assignments as Needed
- Modify/Repeat/Model directions
- necessary assignments only
- Other (specify in plans)
- other- named in lesson
- provide assistance and cues for transitions

- provide daily assignment list
- read class materials orally
- reduce work load
- shorten assignments
- study guide/outline
- utilize multi-sensory modes to reinforce instruction

## **Environment**

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- alter physical room environment
- assign peer tutors/work buddies/note takers
- assign preferential seating
- individualized instruction/small group
- modify student schedule (Describe)
- other- please specify in plans
- provide desktop list/formula

## **Honors Modifications**

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## **Resources**

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- <https://deltamath.com/>
- <https://education.ti.com/en/timathnspired/us/algebra-1>
- [www.Khanacademy.com](http://www.Khanacademy.com)
- [www.mathforum.com](http://www.mathforum.com)

## **Special Education Pull Out Essential Skills:**

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- 1. The artist will be able to understand function notation and its connection to the coordinate plane.
- 2. The artist will be able to perform mathematical operations upon given functions.
- 3. The artist will be able to understand the connection between domain and range.
- 4. The artist will be able to solve linear functions given a discrete domain or range.