

# Unit 1B: Linear Functions and Systems

Content Area: **Mathematics**  
Course(s): **Algebra 1**  
Time Period: **1 marking period**  
Length: **7 Weeks**  
Status: **Published**

## Unit Overview

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This unit opens with an introduction to functions. Students will be asked to identify functions and will gain familiarity with some of the key ideas and terminology associated with functions. From there, they will move into a study of linear functions including rates of change. Focuses will include identifying and comparing slopes, as well as writing and graphing linear functions, based on information presented in varied forms (tables, lists of ordered pairs, equations, graphs, and information regarding parallel/perpendicular lines). Following this, students will study linear inequalities. From there, they will move on to study systems of linear equations and inequalities. Throughout the unit, emphasis will be placed on creating and using equations and inequalities to model real world situations and solve real world problems.

## Transfer

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Students will be able to independently use their learning to...

- Relate algebraic terminology to real life problems/applications.
- Apply content to relevant situations that occur both inside and outside of their math classes.

## Meaning

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## Understandings

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Students will understand that...

- Functions are special types of relations that pair each element of the domain with exactly one element of the range.
- Real-world phenomena can be represented efficiently in algebra by using symbols and operations. These symbols may represent unknown quantities which may or may not vary.
- Equations and inequalities can be transformed into equivalent forms so that solutions can be found.
- Critical vocabulary will be utilized throughout this course as well as in the field of mathematics.
- In mathematical relationships, the value for one quantity depends on the value of another quantity.
- Ratios can show a relationship between changing quantities.
- The solutions to systems of equations and inequalities can be interpreted according to the given

situation

## **Essential Questions**

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Students will keep considering...

- How can mathematical ideas be represented in multiple ways and why can that be important?
- Why is it useful to represent the same mathematical idea in different ways?
- What is the most efficient use of mathematical processes to solve problems?
- How can critical vocabulary terms be used to better enhance the understanding of mathematics?
- How does the value of one variable affect the value of another variable?
- How can average rate of change be determined graphically, numerically, symbolically, or verbally?

## **Application of Knowledge and Skill**

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### **Students will know...**

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Students will know...

- Key features of a function
- Meaning behind the rate of change
- Key features in graphs and tables
- Equations of a line
- Meaning of solutions to an equation and inequality
- Differences between two different functions
- Graphing equations and inequalities on a coordinate plane
- Solving systems of equations and inequalities

## Students will be skilled at...

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Students will be skilled at...

- Distinguishing between functions and other relations
- Identifying the key features of a function
- Sketching graphs to represent verbal descriptions of functions
- Calculating and interpreting rate of change
- Identifying key features in graphs and tables (i.e. intercepts, intervals, positive, negative, etc)
- Creating an equation of a line given various parts of equations
- Understanding all solutions to an equation/inequality in two variables
- Comparing two functions (i.e. given one graph and one symbolical)
- Graphing equations and inequalities in two variables.
- Solving systems by using elimination (linear combination), substitution, and graphing

## Academic Vocabulary

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slope	slope intercept form	perpendicular lines	graphing method	domain	rate of change	independent variable
vertical line	standard form for a linear equation	negative slope	zero slope	range	increasing	dependent variable
horizontal line	linear combination method	solution	half plane	maximum	decreasing	origin
x and y axis	systems of equations and inequalities	ordered pair	parallel lines	minimum	function	reciprocal
y intercept	quadrants	graph of a function	graph of an equation	input-output	x and y coordinate	continuous
substitution method	elimination method	undefined slope	positive slope	parent function	coordinate	discrete

## Learning Goal 1.1: Introduction to Functions

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- SWBAT identify, evaluate, and analyze functions.

MA.F-IF.A

Understand the concept of a function and use function notation

MA.F-IF.B

Interpret functions that arise in applications in terms of the context

MA.F-IF.C

Analyze functions using different representations

## Target 1.1.1 - Identifying Functions

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- SWBAT differentiate between functions and other relations using tables of values, graphs, equations and/or mapping diagrams (DOK: 2 - comprehension)
- SWBAT explain what a function is (DOK: 1 - Retrieval)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.F-IF.A	Understand the concept of a function and use function notation
MA.K-12.2	Reason abstractly and quantitatively.
MA.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 $y = f(x)$ .
MA.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.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.6	Attend to precision.

## Target 1.1.2 - Key Features

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- SWBAT describe key terms related to functions, including function notation, input, output, increasing, decreasing, continuous, discrete, dependent and independent variables, domain, and range. (DOK: 1 - Retrieval)

MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.F-IF.B	Interpret functions that arise in applications in terms of the context
MA.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.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.

## Target 1.1.3 - Working with Key Features

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- SWBAT draw simple graphs to depict situations that have been described. (DOK: 3 - Analysis)
- SWBAT identify key features of functions presented in various formats. (DOK: 2 - Comprehension)

MA.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.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

## Learning Goal 1.2: Linear Functions

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- Create, graph, and interpret linear functions.

MA.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.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.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).

### **Target 1.2.1 - Rate of Change**

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*Suggested Class Activity: TI Calculator/CBR Slope Exploration--Walk the Line*

- Calculate and interpret the average rate of change of a function. (DOK: 3- Analysis)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.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.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.

### **Target 1.2.2 - Slope**

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- SWBAT determine and compare slopes given equations, sets of ordered pairs, tables and/or graphs of functions. (DOK: 2 - Comprehension)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.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.
MA.K-12.8	Look for and express regularity in repeated reasoning.

### **Target 1.2.3 - Writing Linear Functions**

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*Given a slope and y-intercept, a point and a slope, two ordered pairs, a table, graph, or one ordered pair and information regarding a parallel/perpendicular line...*

- SWBAT write a linear function in slope intercept form. (DOK: 2 - Comprehension)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.6	Attend to precision.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.F-BF.A	Build a function that models a relationship between two quantities
MA.F-BF.A.1	Write a function that describes a relationship between two quantities.

## Target 1.2.4 - Graphing Linear Functions

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- SWBAT graph linear functions. (DOK: 2 - Comprehension)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.F-IF.C	Analyze functions using different representations
MA.K-12.7	Look for and make use of structure.
MA.F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

## Target 1.2.5 - Identifying Key Features

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- Given the table, graph, or equation of a linear function, SWBAT determine key features of the function. (Key features to include intercepts, domain, range, and whether the function is increasing, decreasing, or constant) (DOK: 3 - Analysis)

MA.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.
MA.F-IF.B.5	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.
MA.K-12.7	Look for and make use of structure.

## Target 1.2.6 - Real World Applications

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- SWBAT create and use linear functions to model real world situations. (DOK: 4 - Knowledge Utilization)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.F-IF.B.5	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.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

## Learning Goal 1.3: Systems of Equations

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- Create and solve systems of linear equations.

MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-REI.C.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

### Target 1.3.1 - Understanding Solutions to Systems of Equations

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- SWBAT describe what is meant by a solution to a linear equation, as well as which points on the coordinate plane represent solutions to a given equation. (DOK: 3 - Analysis)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.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).

### Target 1.3.2 - Systems of Equations: Graphically

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- SWBAT solve systems of linear equations in two variables by graphing (DOK: 2 - Comprehension)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.

MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-REI.C	Solve systems of equations
MA.A-REI.C.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
MA.A-REI.D.11	Explain why the $x$ -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$ ; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

### Target 1.3.3 - Systems of Equations: Algebraically

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- SWBAT solve systems of equations in two variables using the elimination method. (DOK: 2 - Comprehension)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.A-REI.C	Solve systems of equations
MA.A-REI.C.5	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
MA.A-REI.C.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

### Target 1.3.4 - Real World Applications

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- SWBAT create systems of equations in two variables to model real world situations and answer related questions. (DOK: 4 - Knowledge Utilization)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.4	Model with mathematics.
MA.F-BF.A.1	Write a function that describes a relationship between two quantities.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.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.

### Learning Goal 1.4: Linear Inequalities

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- SWBAT create and solve systems of linear inequalities, recognizing their limitations.

MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.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.
MA.A-REI.D.12	Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

### **Target 1.4.1 - Understanding Solutions to Linear Inequalities**

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- SWBAT describe what is meant by a solution to a linear inequality, as well as which points on the coordinate plane represent solutions to a given inequality. (DOK: 2 - Comprehension)

MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.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).

### **Target 1.4.2 - Solving Linear Inequalities**

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- SWBAT solve linear inequalities in two variables (DOK: 2 -Comprehension)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.A-REI.D.12	Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

### **Target 1.4.3 - Solving Systems of Linear Inequalities (Level of Difficulty: Comprehension)**

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- SWBAT solve a system of linear inequalities with two variables

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.

MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.A-REI.D.12	Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

## Target 1.4.4 - Real World Applications

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- SWBAT create and solve systems of linear inequalities in two variables to solve real world problems. (DOK: 4 - Knowledge Utilization)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.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.
MA.A-REI.D.12	Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

## Formative Assessment and Performance Opportunities

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- Academic Games
- Classroom Discussions
- Classwork
- Closures
- Do Nows
- Group work
- homework
- stations
- student/teacher discussions
- think-pair-share

## Summative Assessment

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- Performance Task
- Test/Quiz
- Unit Exam

## **21st Century Life and Careers and Technology**

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CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP3	Attend to personal health and financial well-being.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.

## **Accommodations and Modifications**

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- Common Core Workbook Reference 3-2 (Relations and Functions)
- Common Core Workbook Reference 3-3 (Writing Functions)
- Common Core Workbook Reference 4-1 (Identifying Linear Functions)
- Common Core Workbook Reference 4-2 (Using Intercepts)
- Common Core Workbook Reference 4-3 (ROC and Slope)
- Common Core Workbook Reference 4-4 (Slope Formula)
- Common Core Workbook Reference 4-6 (Slope Intercept Form)
- Common Core Workbook Reference 4-9 (Slopes of Parallel and Perpendicular Lines)
- Common Core Workbook Reference 5-1 (Solving Systems by Graphing)
- Common Core Workbook Reference 5-3 (Solving Systems by Elimination))
- Common Core Workbook Reference 5-4 (Solving Special Systems)
- Common Core Workbook Reference 5-5 (Solving Linear Inequalities)
- Common Core Workbook Reference 5-6 (Solving Systems of Linear Inequalities)
- Create alternate projects or assignments
- IEPs
- small group questions
- use of technology - TI-83 calculator to solve systems and find intercepts
- use timer for time management

## Unit Resources

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- Explorations in Core Math for Common Core: Algebra 1 (Holt McDougal)
- Illustrative Mathematics
- Khan academy
- Kuta software
- PARCC/NJSLA released questions

## Interdisciplinary Connections

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Real world applications involving systems of equations and Rate of change to make financial decisions. Help students to compare different companies. (MA.9-12.A-CED.A.3)

PFL.9.1.12.E.2

Analyze and apply multiple sources of financial information when prioritizing financial decisions.