

# Unit 01 - Linear and NonLinear Functions

Content Area: **Math**  
Course(s):  
Time Period: **Full Year**  
Length: **26 days**  
Status: **Published**

## **General Overview, Course Description or Course Philosophy**

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In Grade 8, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

In this unit, students will recognize and model linear and nonlinear relationships as they occur in bivariate data. Students will also measure variation in data and strength of its association to the bivariate data.

## **OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS**

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### **Essential Questions:**

- Why does one need to define a function?
- When should functions be evaluated and compared?
- How does knowing the algebraic properties of a function help to graph that function?
- What applications could be represented by variables that are not related by a linear function?
- How can you define a function given a set of ordered pairs, an equation or a graph of the function?
- How does knowing the algebraic properties of a function help to graph that function?
- What applications or situations could be modeled by variables that represent non-linear functions?
- How can you represent data patterns using graphs, tables, word descriptions, and algebraic expressions?
- How does the nature of linear functions appear in the context of a situation?
- How can mathematical models be used to answer questions about linear relationships?
- How do you write linear functions from verbal, numerical, or graphical information?
- How can data be used to make predictions?
- How does a line of best fit to a data set help to determine a linear trend and measure closeness of fit?
- How does a scatter plots of bivariate data help to determine the strength of the linear association between the two variables?
- How can two-way tables be used to aid in the analysis of cell frequencies and relative frequencies to decide whether two variables are related?

### **Enduring Understandings:**

- An ordered pair that satisfies a function is the  $(x, y)$  that makes the equation true.

- Properties of functions when they are represented

-algebraically

-graphically

-numerically in tables

-by verbal descriptions

- $y = mx + b$  defines a linear function whose graph is a straight line.
- When the points on a graph do not fall in a straight line, the function is not linear.
- When one variable is dependent on the other, a function can model the data pattern. Functions allow you to answer questions or make predictions about a relationship. Linear relationships are functions.
- Data about two variables from real-world observations or experiments can be collected and represented in graphs and tables. These representations are useful for analyzing relationships among data, including the variability of the data.
- Data may show a pattern or association between the data. Sometimes you can fit a line to data, find the equation of the line, and measure how well the line fits the data pattern. This is useful for making predictions about data points not observed.
- Categorical data must be analyzed in different ways than numerical data including using 2-way tables to analyze relative frequencies.

## **STUDENT LEARNING TARGETS**

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Refer to the 'Declarative Knowledge' & 'Procedural Knowledge' Sections

### **Declarative Knowledge**

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Students will understand that:

- a function is a rule that assigns to each input exactly one output.
- the graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
- functions can be represented in 4 different ways:
  - algebraically
  - graphically
  - numerically in tables
  - by verbal descriptions
- straight lines are widely used to model relationships between two quantitative variables

### **Procedural Knowledge**

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Students will be able to:

- compare two different proportional relationships represented in two different ways
- interpret the unit rate as the slope of the graph of a proportional relationship
- graph proportional relationships
- give examples of linear equations in one variable with one solution, infinitely many solutions, or no solution
- solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms
- describe the relationship between the input and output of a function
- identify functions in tables of ordered pairs and equations
- compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)
- interpret the equation  $y = mx + b$  as defining a linear function, whose graph is a straight line
- give examples of functions that are not linear
- interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or table of values
- construct a function to model a linear relationship between two quantities
- describe qualitatively the functional relationship between two quantities by analyzing a graph
- sketch a graph that exhibits the qualitative features of a function that has been described verbally
- interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities
- construct scatter plots for bivariate measurement data
- judge the closeness of the data points to the line in scatter plots that suggest a linear association
- interpret the slope and intercept of the equation of a linear model in the context of bivariate measurement data
- solve problems in the context of bivariate measurement data using the equation of a linear model
- construct a two-way table summarizing data on two categorical variables collected from the same subjects
- interpret a two-way table summarizing data on two categorical variables collected from the same subjects

## **CONTENT AREA STANDARDS**

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8.NS

A. Know that there are numbers that are not rational and approximate them by rational numbers

8.EE

A. Work with radicals and integer exponents

B. Understand the connections between proportional relationships, lines, and linear equations

C. Analyze and solve linear equations and pairs of simultaneous linear equations

8.F

A. Define, evaluate and compare functions

B. Use functions to model relationships between quantities

8.G

A. Understand congruence and similarity using physical models, transparencies, or geometry software

B. Understand and apply the Pythagorean Theorem

C. Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres

8.SP

A. Investigate patterns of association in bivariate data

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.K-12.7	Look for and make use of structure.
MA.8.EE.B.5	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.8.EE.C.7	Solve linear equations in one variable.
MA.8.EE.C.7b	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
MA.8.F.A.1	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
MA.8.F.A.2	Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MA.8.F.A.3	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
MA.8.F.B.4	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two $(x, y)$ values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
MA.8.F.B.5	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

MA.8.SP.A.1	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
MA.8.SP.A.2	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit (e.g. line of best fit) by judging the closeness of the data points to the line.
MA.8.SP.A.3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
MA.8.SP.A.4	Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

## **RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)**

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- 9.1.8.PB.1: Predict future expenses or opportunities that should be included in the budget planning process. •  
 9.1.8.PB.2: Explain how different circumstances can affect one's personal budget.

LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
LA.K-12.NJSLSA.L1	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
CS.6-8.8.1.8.DA.1	Organize and transform data collected using computational tools to make it usable for a specific purpose.
CS.K-12.3	Recognizing and Defining Computational Problems
CS.K-12.5	Creating Computational Artifacts
CS.K-12.6	Testing and Refining Computational Artifacts
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
TECH.9.4.8.IML.4	Ask insightful questions to organize different types of data and create meaningful visualizations.

## **EVIDENCE OF LEARNING**

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Refer to the 'Formative, Summative, and Benchmark Assessment' Sections

## **Alternate Assessments**

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- Portfolios
- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

## **Formative Assessments**

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Mathematical Reflections

Check Up 1

Check Up 2

Self Assessment Questions

Delta Math Assignments

## **Summative Assessments**

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Partner Quiz

Teacher created assessments (both test generator and teacher generated questions)

OnCourse generated assessments

Delta Math teacher generated assessments

## **Benchmark Assessments**

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- BOY Diagnostic Snapshot Assessment
- MP1 Quarterly Assessment
- MP2 Quarterly Assessment
- MP3 Quarterly Assessment
- MP4 Quarterly Assessment

- EOY Diagnostic Snapshot Assessment

## **INTERDISCIPLINARY CONNECTIONS**

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- Data collection/analysis
- Statistics
- Financial/Economic/Business/Entrepreneurial Literacy

## **RESOURCES (Instructional, Supplemental, Intervention Materials)**

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### **Core Instructional Materials**

- Reveal Math - Course 3
- [Delta Math](#)

### **Supplemental/Intervention Materials**

- [Khan Academy](#)
  - [Functions and Linear Models](#)
- [NCTM](#)
  - [Walk the Plank](#)
  - [Barbie Bungie](#)
  - [Light it Up](#)
  - [Correlation and the Regression Line](#)
- [Illustrative Mathematics](#)
  - [8.3 Linear Relationships](#)
  - [8.5 Functions and Volume - Lessons 1-9](#)

## **ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS**

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See link to Accommodations & Modifications document in course folder.

