Unit 03: Linear Functions

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **6 weeks**
Status: **Published**

Standards Alignment

New Jersey Student Learning Standards

MATH.8.EE	Expressions and Equations
MATH.8.EE.A	Work with radicals and integer exponents
MATH.8.EE.A.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
	For example, $3^2 \times (3^{-5}) = (3^{-3}) = 1/(3^3) = 1/27$.
MATH.8.EE.A.2	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number.
MATH.8.EE.A.2.a	Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
MATH.8.EE.A.2.b	Simplify numerical radicals, limiting to square roots (i.e., nonperfect squares).
MATH.8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
	For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.
MATH.8.EE.A.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
MATH.8.EE.B	Understand the connections between proportional relationships, lines, and linear equations
MATH.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.
	For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
MATH.8.EE.B.6	Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.
MATH.8.EE.C	Analyze and solve linear equations and pairs of simultaneous linear equations
MATH.8.EE.C.7	Solve linear equations in one variable.
MATH.8.EE.C.7.a	Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively

	transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
MATH.8.EE.C.7.b	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
MATH.8.EE.C.8	Analyze and solve pairs of simultaneous linear equations.
MATH.8.EE.C.8.a	Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
MATH.8.EE.C.8.b	Solve systems of two linear equations in two variables using the substitution method and estimate solutions by graphing the equations. Solve simple cases by inspection. For example: by inspection, conclude that $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6. Solve $3x + y = 30$ and $y = 2x$ using the substitution method; Solve $y = 3x + 1$ and $y = -2x + 7$ using the substitution method.
MATH.8.EE.C.8.c	Solve real-world and mathematical problems leading to two linear equations in two variables.
MATH.8.F	Functions
MATH.8.F.A	Define, evaluate and compare functions
MATH.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. Function notation is not required in Grade 8.
MATH.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). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
MATH.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. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1, 1), (2, 4) and (3, 9), which are not on a straight line.
MATH.8.F.B	Use functions to model relationships between quantities
MATH.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.
MATH.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.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.

Integration of Career Readiness, Life Literacies and Key Skills

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
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.CRP5	Consider the environmental, social and economic impacts of decisions.
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.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Technology / Integration of Computer Science and Design Thinking

CS.6-8.8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
CS.6-8.8.1.8.CS.3	Justify design decisions and explain potential system trade-offs.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.

Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math Section

ELA.SL.PE.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
ELA.SL.II.8.2	Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
ELA.SL.ES.8.3	Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
ELA.SL.PI.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
ELA.SL.UM.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media

LiteracyNew Section

see Crosswalks

21st Century Life and Careers

CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.

Stage I: Desired Results

Transfer/Overview/Rationale

Transfer / Overview / Rationale
Unit Rationale   The purpose of this unit…   **The purpose of this unit is to understand different types of functions and how they apply to real-world situations. More specifically, students will analyze linear relationships in order to recognize constant rate patterns.**

Meaning

Essential Questions

Essential Questions

-What are the advantages and disadvantages of representing functions using tables, graphs, and equations?

-How does identifying and understanding linear functions versus nonlinear functions help to solve a variety of problems?

-Why is it important to determine and describe the relationship between two variables?

Enduring Understanding/Indicators of Understanding

-Understand the importance of representing functions in a variety of ways in order to best describe the relationship between two variables

-Understand that a relationship that shows a constant rate of change is a linear function and is represented by the equation $y = mx + b$ and those that do not have a constant rate of change are nonlinear functions

-Understand and describe the relationship between two sets of data

Acquisition (Student Learning Objectives)

Knowledge

Students will know…

-How to determine whether a relation is a function

-How to graph functions

-Representations of real-world stories and data in the form of line graphs or scatter plots

-How to determine if a function is a linear function from a variety of representations

-Definition of slope and how it affects the relationship between two variables

-Slope-intercept form

-How to recognize proportional relationships

Skills

Student will be skilled at …

-Determine if relations are functions from graphs, tables, and ordered pairs

-Graph a variety of functions by creating tables of input and output values

-Evaluate functions to find output values when given input values

-Create a graph based on a real-world situation and vice versa

-Generate a scatter plot from a given set of bivariate data

-Identify the correlation between bivariate data when given a scatter plot and describe a corresponding real-world situation

-Develop a line of best fit for a given set of bivariate data

-Classify a function as linear or nonlinear

-Determine the slope/rate of change for linear functions represented in tables, graphs, and ordered pairs

-Write an equation in slope-intercept form from a variety of representations

-Identify the slope and y-intercept of linear functions given in a variety of representations and use them to create a graph

-Determine if a given relationship is proportional

Stage 3: Learning Plan

Resource and Mentor Texts

Resources and Mentor Texts

Unit 3 activities.docx

Formative Assessment Strategies

Formative Assessment Strategies

- ixl.com scores
- tenmarks.com scores
- teacher center observation
- STEM projects

Learning Activities/Unit of Study

Learning Activities/Unit of Study

Linear Functions: Approximately 6 Cycles

Cycle 1: Topics Covered

- Functions vs. Non functions
- Graph all types of functions (create tables from equations)

- Activities/Centers
  - IXL.com centers
    - X.1 Identify functions
    - X.15 Does (x, y) satisfy the nonlinear function?
  - Tenmarks centers
    - 8.F.1 Graphing Functions
    - 8.F.1 Determining If a Relation Is a Function
  - Hands-On/Creative Centers
    - Sort function vs. non function: https://app.box.com/s/d800e30494a4b21f54a5
  - Online games

- - http://www.softschools.com/quizzes/algebra/identifying_functions_as_relations/quiz5586.html
  - ○ Xtramath: review flashcards
  - ○ Teacher Directed Stations
    - ▪ Bellringers: Week 30—page 91-92
    - ▪ Bellringers: Week 30—page 89-90
    - ▪ Teacher created problems on white boards: given an equation make a table of values
  - ○ STEM activity: Create a discovery jar. Have students brainstorm all of the questions or ideas he/she is curious about related to science, technology, engineering, art, or math. Maybe it is why grass is green or how space travel started. Or how many varieties of leaves exist on the trees in the yard. Then put all of the questions into a mason jar. Each group chooses out of the jar at a center and will research and explore the topic. (This activity can be repeated throughout the year and questions can be added as well).* (see previous unit attachments)

Cycle 2: Topics Covered

- Graphs and stories
- Scatterplots

- Activities/Centers
  - ○ IXL.com centers
    - ▪ AA.14 Scatter plots
    - ▪ AA.4 Interpret line graphs
  - ○ Tenmarks centers
    - ▪ 8.SP.1 Identifying the Correlation Between Two Quantities
    - ▪ 8.SP.3 Interpreting Scatter Plots
    - ▪ 8.F.5 Describing a Graph
  - ○ Hands-On/Creative Centers
    - ▪ Describing a graph activity: https://teacher.desmos.com/carnival
  - ○ Xtramath: review flashcards
  - ○ Teacher Directed Stations
    - ▪ Bellringers: Week 29—page 87-88
    - ▪ Bellringers: Week 29—page 85-86
- STEM activity: scatterplot lesson*

Cycle 3: Topics Covered

- Linear vs. Non linear
- Graphing linear functions

- Activities/Centers
  - ○ IXL.com centers
    - ▪ X.7 Complete a table for a linear function
    - ▪ X.8 Complete a table and graph a linear function
    - ▪ X.9 Interpret the graph of a linear function: word problems
    - ▪ X.10 Write a linear function from a table
    - ▪ X.11 Compare linear functions: graphs, tables, and equations
    - ▪ X.14 Identify linear and nonlinear functions
  - ○ Tenmarks centers

- - - 8.F.4 Identifying Linear Equations
  - 8.F.3 Understanding Linear Functions
  - 8.F.3 Identifying Graphs of Functions
  - 8.F.1 Graphing Functions
  - Hands-On/Creative Centers
    - Linear vs. nonlinear: http://www.cpalms.org/Public/PreviewResourceLesson/Preview/48283
  - Online games
    - Graphing linear equations: http://www.mathplayground.com/SaveTheZogs/SaveTheZogs.html
  - Xtramath: review flashcards
  - Teacher Directed Stations
    - Bellringers: Week 29—page 83-84
    - Bellringers: Week 29—page 81-82
    - Teacher created problems on white boards: graph linear equations

Cycle 4: Topics Covered

- Slope

- Activities/Centers
  - IXL.com centers
    - X.4 Rate of change
    - X.5 Constant rate of change
    - W.1 Find the slope of a graph
    - W.2 Find the slope from two points
    - W.3 Find a missing coordinate using slope
    - W.4 Find the slope of an equation
    - W.5 Graph a line using slope
  - Tenmarks centers
    - 8.F.4 Rate of Change
  - Hands-On/Creative Centers
    - Slope activity: file:///C:/Users/KKemeny/Downloads/slopemini-project.pdf
  - Online games
    - Find the slope: https://www.quia.com/rr/79713.html
  - Xtramath: review flashcards
  - Teacher Directed Stations
    - Bellringers: Week 28—page 79-80
    - Bellringers: Week 28—page 77-78
    - Teacher created problems on white boards: find the slope from two points
- STEM activity: https://illuminations.nctm.org/Lesson.aspx?id=2858

Cycle 5: Topics Covered

- Slope-intercept form from tables, graphs, and two points

- Activities/Centers
  - IXL.com centers
    - W.6 Graph a line from an equation
    - W.7 Write a linear equation from a slope and y-intercept

- W.8 Write a linear equation from a graph
- W.9 Write a linear equation from a slope and a point
- W.10 Write a linear equation from two points
  - Tenmarks centers
    - 8.F.4 Identifying Linear Equations
    - 8.F.3 Understanding Linear Functions
  - Hands-On/Creative Centers
    - Five stations on identifying slope and y-intercept*
  - Online games
    - http://www.math-play.com/slope-intercept-game.html
  - Xtramath: review flashcards
  - Teacher Directed Stations
    - Bellringers: Week 28—page 75-76
    - Bellringers: Week 28—page 73-74
    - Teacher created problems on white boards: create y = mx + b from two points
- STEM activity: http://illuminations.nctm.org/lesson.aspx?id=3667

Cycle 6: Topics Covered

- Proportional relationships

- Activities/Centers
  - IXL.com centers
    - I.2 Identify graphs of proportional relationships
    - I.3 Find the constant of proportionality from a graph
    - I.4 Write equations for proportional relationships
    - I.5 Graph proportional relationships
    - I.6 Identify proportional relationships
    - I.7 Find the constant of proportionality: word problems
    - I.8 Solve problems involving proportional relationships
  - Hands-On/Creative Centers
    - Work in partners to solve (start at page 15) http://schools.nyc.gov/NR/rdonlyres/2567D7C1-4506-4950-B03D-2D1C833CD331/0/UnderstandingProportionalRelationships.pdf
  - Xtramath: review flashcards
  - Teacher Directed Stations
    - Bellringers: Week 27—page 71-72
    - Bellringers: Week 27—page 69-70
    - Teacher created problems on white boards: find the unit rate
    - PARCC practice*

Modifications and/or Accommodations

Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing

or sight issues need to be close to the instruction which often means near the front.