Unit 2: Linear Functions and Systems of Linear Equations (5 Weeks)

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **9 Weeks**
Status: **Published**

Unit Rationale

A unit on linear functions and systems of linear equations in Algebra 1 is fundamental for developing students' understanding of algebraic reasoning, problem-solving skills, and mathematical modeling. This unit serves as a cornerstone for more advanced topics in mathematics and practical applications in various fields. Here's a rationale for including a unit on linear functions and systems of linear equations in Algebra 1:

1. Foundation of Algebraic Understanding

- **Introduction to Functions:** Linear functions provide a basic introduction to the concept of functions, which is central to all of algebra and higher mathematics. Understanding linear functions is a critical step toward mastering more complex function types, such as quadratics, exponentials, and polynomials.
- **Concept of Slope and Intercept:** The slope and intercept of a linear function are key concepts that help students understand how changes in variables affect outcomes. Mastery of these concepts allows students to interpret and construct linear models, which is essential for further study in mathematics.

2. Critical Problem-Solving Skills

- **Solving Systems of Equations:** Learning to solve systems of linear equations (by graphing, substitution, and elimination) enhances students' problem-solving abilities. These methods provide multiple strategies for finding solutions, which deepens their understanding of algebraic principles.
- **Application of Algebraic Operations:** Working with linear equations and systems requires students to apply and refine their skills with algebraic operations such as addition, subtraction, and multiplication of expressions. This reinforces their overall algebraic proficiency.

3. Real-World Applications

- **Modeling Relationships:** Linear functions are used to model and analyze relationships between two quantities in various real-world contexts, such as economics, physics, and social sciences. Understanding these models helps students grasp the practical relevance of algebra in everyday life.
- **Decision Making:** Systems of linear equations are often used in decision-making processes, such as optimizing resources or balancing costs and benefits. By learning to solve these systems, students gain the ability to make informed decisions based on mathematical reasoning.

4. Preparation for Higher-Level Math

- **Foundation for Advanced Topics:** Mastery of linear functions and systems is crucial for success in higher-level math courses, including Algebra 2, Pre-Calculus, and Calculus. Many advanced topics, such as matrix algebra and linear programming, build directly on the concepts learned in this unit.
- **Introduction to Linear Algebra:** Understanding linear functions and systems provides a foundation for linear algebra, a critical area of mathematics that is widely used in fields such as engineering,

computer science, and economics.

5. Developing Mathematical Reasoning

- **Connecting Algebra and Geometry:** The study of linear functions allows students to connect algebraic equations with geometric representations, such as the graph of a line. This dual understanding enhances their ability to interpret and analyze data both algebraically and visually.
- **Logical Thinking:** Solving systems of equations requires logical thinking and the ability to apply systematic approaches to find solutions. These skills are valuable not only in mathematics but in many areas that require analytical thinking.

6. Engaging and Accessible Content

- **Variety of Problem Types:** Linear functions and systems offer a wide variety of problem types, from simple equations to complex word problems. This variety keeps students engaged and challenges them to apply their knowledge in different contexts.
- **Visual Learning Opportunities:** Graphing linear functions and systems provides a visual representation of abstract algebraic concepts, making the material more accessible to students who learn best through visual means.

7. Enhancing Data Literacy

- **Interpreting and Analyzing Data:** Linear models are often used to analyze data sets, helping students develop data literacy skills. Understanding how to create and interpret linear models is crucial for analyzing trends, making predictions, and understanding statistical relationships.
- **Critical Thinking:** Students learn to think critically about the relationships between variables and to interpret the meaning of slopes and intercepts in real-world contexts, enhancing their ability to make data-driven decisions.

8. Preparation for Standardized Testing

- **Frequently Tested Concepts:** Linear functions and systems of equations are commonly tested topics on standardized exams like the SAT, ACT, and state assessments. Mastery of these concepts is essential for students to perform well on these tests, particularly in sections that involve algebraic reasoning and problem-solving.

By including a unit on linear functions and systems of linear equations in Algebra 1, educators provide students with essential tools for understanding and analyzing relationships, solving problems, and modeling real-world situations. This unit lays the groundwork for success in higher-level mathematics and equips students with skills that are valuable across a wide range of academic disciplines and career paths.

Pre-Assessment

- HMH- Math Language Routines Library
- "Are you ready"- at the beginning of all modules.

- Before you begin- interactive lessons

Module 4: Linear Functions and Models

All materials are listed in HMH

Instructional Plan

Lesson 1: Relations and Functions

Lesson 2: Linear Functions

Lesson 3: Characteristics of Linear Functions

Lesson 4: Linear Models and Point-Slope Form

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 5: Relationships Among Linear Functions

All materials are listed in HMH

Instructional Plan

Lesson 1: Transform Graphs of Functions

Lesson 2: Transform Linear Functions

Lesson 3: Compare Linear Functions

Lesson 4: Inverses of Linear Functions

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 6: Fit Linear Functions to Data

All materials are listed in HMH.

Lesson 1: Scatter Plots, Correlation, and Fitted Lines

Lesson 2: Residuals and Best-Fit Lines

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 7: Discrete Linear Functions

Lesson 1: Arithmetic Sequences Defined Recursively

Lesson 2: Arithmetic Sequences Defined Explicitly

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 8: Piecewise-Defined Functions

Lesson 1: Graph Piecewise-Defined Functions

Lesson 2: Graph Absolute Value Functions

Lesson 3: Solve Absolute Value Equations and Inequalities

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 9: Systems of Linear Equations

Lesson 1: Solve Linear Systems by Graphing

Lesson 2: Solve Linear Systems by Substitution

Lesson 3: Solve Linear Systems by Adding or Subtracting

Lesson 4: Solve Linear Systems by Multiplying First

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 10: Linear Inequalities

Lesson 1: Linear Inequalities in Two Variables

Lesson 2: Graph Systems of Linear Inequalities

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Standards

New Jersey Student Learning Standards: Content Area

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics
MATH.K-12.5	Use appropriate tools strategically
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.K-12.8	Look for and express regularity in repeated reasoning
MATH.9-12.A.CED.A.1	Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
MATH.9-12.A.REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
MATH.9-12.A.REI.C.6	Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
MATH.9-12.A.REI.C.8	Represent a system of linear equations as a single matrix equation in a vector variable.
MATH.9-12.A.REI.D	Represent and solve equations and inequalities graphically
MATH.9-12.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.

Integration of Computer Science and Design Thinking

CS.9-10.3A-AP-14	Use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables.

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

SOC.K-12.1	Developing Questions and Planning Inquiry
ELA.K-12.L.KL	Knowledge of Language: By the end of grade 12, apply knowledge of language and command of vocabulary to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
MATH.9-12.S.IC	Making Inferences and Justifying Conclusions
ELA.K-12.SL.UM	Use Media: By the end of grade 12, make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

Integration of Career Readiness. Life Literacies and Key Skills

TECH.9.4.2.CI	Creativity and Innovation
TECH.9.4.2.CT	Critical Thinking and Problem-solving
	A variety of diverse sources, contexts, disciplines, and cultures provide valuable and necessary information that can be used for different purposes.
	Digital tools can be used to display data in various ways.

21st Century Life and Career

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.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.

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

Diversity, Equity, and Inclusion

NCTM: Access and Equity in Mathematics Education

A Pathway to Equitable Math Instruction

Provide students with opportunities to give feedback to teachers about the classroom and instruction.

• Verbal Example: Fist to five, How well do you understand what we talked about today? Fist to five, How well did I teach this today?

• Classroom Activity: Exit tickets or surveys that ask students to identify how well teachers taught, what helped them learn, what got in the way of their learning, etc.

Treat mathematics as a language that everyone is learning while authentically centering students home languages.

• Classroom Strategies: Color-coding ideas, learning vocabulary in student languages, visual and kinesthetic learning, representations of learning without words.

• Classroom Activity: Multilingual Frayer Models for
definitions or concepts

Incorporate true culturally relevant pedagogy, practice, and curriculum.

• Verbal Example: What are some of your family traditions that you are proud of? Would you be okay if we brought some of those into the classroom?

• Classroom Activity: Use Ankara fabric to teach mathematical concepts such as tessellations, fractions, area, percentages, etc.

Incorporate the history of mathematics into lessons.
• Verbal Example: Why do you think we call it Pythagorean's theorem, when it was used before he was even born? What should we call it instead?
• Classroom Activity: Learn about different bases and numerical ideas: Base 2, binary and connections to computer programming, how the Yoruba of Nigeria used base 20, and how the Mayans conceptualized the number 0 before the first recording of it

Solicit student ways of thinking and processing.
• Verbal Example: How might you all go about this? What do you notice?
• Classroom Activity: Incorporate explorations, where students interact with mathematics in a way that allows them to "discover" or experience mathematics.

Reorganize your classroom teaching around concepts, and teach them more like a web rather than discrete sets of knowledge.
• Verbal Example: How does this connect to what you've learned in the past? How can you use that

knowledge today?
• Classroom Activity: Learning webs that connect content

Start with more complex math problems and scaffold as necessary.
• Verbal Example: If we wanted to build a rocket, what are all the things we might need to know before we get started? Along the way, we decided that we want the rocket to reach the moon. What do we need to consider now?
• Classroom Activity: When solving equations, start with the most complex problem, generate ideas for how to solve it, and use the simpler equations as examples to support those ideas.

Offer a variety of ways to demonstrate thinking and knowledge.
• Verbal Example: Show your thinking with words, pictures, symbols.

Ask other questions that will demonstrate learning when it is not clear to you how students know the answer.
• Verbal Example: If you were working with a fellow mathematician who was absent this day, what might you tell them to help them learn it?

Learn about, engage with, and incorporate ethnomathematics.
• Verbal Example: Reflect on your day so far. What math have you already used today?
• Classroom Activity: Community walks to engage with slope.

Co-construct knowledge in the classroom.
• Verbal Example: Let's get into partners and do a think pair-share. We will incorporate everyone's ideas and try to synthesize them.
• Classroom Activity: Have students create mathematical definitions in their own words in groups, and bring the groups together to co-construct mathematical definitions as a class

Choose problems that have complex, competing, or multiple answers.
• Verbal Example: Come up with at least two answers that might solve this problem.
• Classroom Activity: Challenge standardized test questions by getting the "right" answer, but justify other answers by unpacking the assumptions that are made in the problem.
• Classroom Activity: Deconstructed Multiple Choice
- given a set of multiple choice answers, students discuss why these answers may have been included (can also be used to highlight common mistakes).

Identify what is right about the thinking, and highlight the mistake in what is factually or procedurally accepted.
• Verbal Example: You recognized that you had to combine the constants 27 and 9, could you explain your thinking?

• Classroom Activity: Error Analysis worksheets that highlight what is the right idea behind the mistake.

Using thoughtful questioning to solicit mathematical thoughts rather than telling.

• Verbal Example: What would a mathematician who is confused ask about this question?

• Classroom Activity: After students demonstrate knowledge of a topic, have them play a game where they have to explain their topic to a fellow mathematician and a skeptic. Develop their own reflective questioning/explaining in all three roles.

Create multiple ways of participating that honor myriad ways of thinking and being.
• Verbal Example: For this section, feel free to work alone, in pairs, trios, or quads (let them choose).
• Classroom Activity: Community circles or storytelling circles, incorporating dance, music, song, call and response, and other cultural ways of communicating.

Climate Change

Math Climate Change Companion Guide

• S.ID.B.6a Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.
Climate Change Example: Students may use linear or exponential functions fitted to geoscience data to solve problems and analyze the results from global climate models to make an evidence-based forecast of the current rate of global climate change.

• 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.
Climate Change Example: Students may use function notation to determine the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline), m, where c(m) is the number of molecules of carbon dioxide.
• 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 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.
Climate Change Example: Students may relate the domain of a function c(m) representing the amount of carbon dioxide produced by burning m molecules of ethane (gasoline), to its graph in order to determine the appropriate domain for c(m).
• 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.
Climate Change Example: Students may calculate the average rate of change of a function c(m) presented symbolically or as a table, where c(m) represents the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline).

• A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.

• 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. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
Climate Change Example: Students may represent constraints describing the economic impact of climate change by equations, inequalities, and/or by systems of inequalities, and interpret solutions as viable or nonviable options.
• A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law to highlight resistance R.
Climate Change Example: Students may rearrange formulas related to the economic impact of climate change to highlight a quantity of interest, using the same reasoning as in solving equations.

• N.Q.A.1 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.
Climate Change Example: Students may use units to guide the solution of multi-step problems about how variations in the flow of energy into and out of the Earth's systems result in climate change. Note: Changes in climate are limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.
• N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
Climate Change Example: Students may define appropriate quantities for a descriptive model of how variations in the flow of energy into and out of Earth's systems result in climate change. Note: changes in climate are limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.