Course Title:	Content Area:	Grade Level:	Credit (if applicable)
Algebra 1 (Academic)	Math	Gr. 9-10	1.0 (Full Year)

Course Description:

This Algebra 1 course develops students' understanding of algebraic relationships, progressing systematically from linear through exponential and quadratic functions. Beginning with linear equations and systems, students learn to create, graph, and solve equations in both one and two variables. They then extend these concepts to inequalities and systems of inequalities, learning to represent and interpret constraints in context. Throughout these initial units, students also analyze bivariate data and develop linear models, connecting algebraic representations to real-world situations.

The middle portion of the course formalizes students' understanding of functions as mathematical relationships. Students learn to use function notation, analyze key features of graphs, and interpret different representations of functions. This foundation enables them to explore exponential functions, where they contrast exponential and linear growth, apply properties of exponents, and model real-world growth and decay scenarios. The course concludes with an introduction to quadratic functions, where students analyze different forms of quadratic expressions, graph parabolas, and interpret key features in context.

Throughout the six units, students engage in mathematical practices that develop their ability to problem-solve, model real-world situations, and construct mathematical arguments. The course emphasizes multiple representations of relationships (graphs, equations, tables, and verbal descriptions) and the connections between them.

Aligned Core Resources:

https://accessim.org/hs?a=teacher
IM360 Changes

Connection to the *BPS Vision of the Graduate*

Problem Solving
- IM's focus on real-world modeling and problem-solving strategies
- Multiple solution pathways are encouraged and explored
- Students develop perseverance through challenging tasks

Critical Thinking
- Students analyze mathematical relationships and justify their reasoning
- Regular opportunities to critique others' reasoning
- Emphasis on understanding "why" not just "how"

Communication and Collaboration
- Structured mathematical discourse is built into lessons
- Students explain their thinking both verbally and in writing
- Many activities involve partner and group work

Additional Course Information:
Knowledge/Skill Dependent courses/prerequisites

The following skills are foundational for success in IM Algebra 1. These skills are developed in grades 6-8 and form the foundation for algebraic thinking and problem-solving in IM Algebra 1.

Properties of Operations
- Apply order of operations with rational numbers
- Use distributive property to expand and factor expressions
- Understand and apply integer exponents

Linear Relationships
- Recognize proportional relationships from tables, graphs, and equations
- Understand slope as a rate of change
- Graph points in the coordinate plane

Variable Expressions
- Evaluate expressions by substituting values for variables
- Combine like terms and simplify basic algebraic expressions

One-Step and Two-Step Equations
- Solve equations using inverse operations
- Check solutions by substitution

Number Sense
- Work fluently with fractions, decimals, and percentages
- Understand rational and irrational numbers

Data Analysis
- Create and interpret basic data displays

Link to *Completed Equity Audit*

Equity Curriculum Review - Algebra 1 ACA (2025)

• Calculate measures of center (mean, median)	

Standard Matrix

Standard	Lesson(s)																	
HSA-APR.A	U6 L8	U6 L9																
HSA-CED.A.1	U3 L3	U4 L13																
HSA-CED.A.2	U1 L1	U1 L2	U1 L3	U1 L5	U1 L6	U5 L3	U5 L4	U5 L5	U5 L6	U5 L7								
HSA-CED.A.3	U1 L1	U1 L2	U1 L3	U1 L5	U1 L9	U1 L10	U1 L12	U1 L17	U3 L1	U3 L3	U3 L5	U3 L6	U3 L7	U3 L9				
HSA-CED.A.4	U1 L8	U1 L9	U1 L10	U1 L11	U4 L16													
HSA-REI.A	U1 L4	U1 L7	U1 L12															
HSA-REI.A.1	U1 L6	U1 L7	U4 L5															
HSA-REI.B.3	U1 L4	U1 L8	U1 L9	U3 L2	U3 L3													
HSA-REI.C	U1 L18	U1 L19																
HSA-REI.C.5	U1 L16																	
HSA-REI.C.6	U1 L12	U1 L13	U1 L14	U1 L15	U1 L16	U1 L17	U1 L18											
HSA-REI.D.10	U1 L5	U1 L10	U1 L11	U3 L5														
HSA-REI.D.11	U4 L9																	
HSA-REI.D.12	U3 L4	U3 L5	U3 L6	U3 L7	U3 L8	U3 L9												
HSA-SSE.A	U5 L9	U5 L17	U6 L8	U6 L11														
HSA-SSE.A.1	U1 L6	U5 L5	U5 L7	U5 L17	U6 L2	U6 L3												
HSA-SSE.A.1.b	U5 L18																	
HSA-SSE.A.2	U6 L8	U6 L9																
HSA-SSE.B.3	U6 L2	U6 L8	U6 L9	U6 L10	U6 L13													
HSA-SSE.B.3.c	U5 L18																	
HSF-BF.A.1	U4 L14	U4 L17	U4 L18	U5 L11	U5 L15	U6 L6												
HSF-BF.A.1.a	U4 L4	U4 L14	U5 L2	U5 L3	U5 L5	U5 L15	U5 L16	U5 L17	U6 L1	U6 L2	U6 L3	U6 L4	U6 L5	U6 L6	U6 L7			
HSF-BF.A.1.b	U1 L2	U1 L14	U1 L15	U1 L16														

HSF-BF.B.3	U4 L14	U6 L12	U6 L13	U6 L15	U6 L17														
HSF-BF.B.4	U4 L15	U4 L16	U4 L17																
HSF-BF.B.4.a	U4 L17																		
HSF-IF.A.1	U4 L1	U4 L2	U4 L4																
HSF-IF.A.2	U4 L2	U4 L3	U4 L4	U4 L5	U4 L12	U4 L17	U5 L8	U5 L9	U5 L11	U5 L17	U5 L18	U5 L19	U6 L3	U6 L5	U6 L14				
HSF-IF.A.3	U6 L2																		
HSF-IF.B	U4 L10	U5 L8																	
HSF-IF.B.4	U4 L1	U4 L2	U4 L3	U4 L4	U4 L5	U4 L6	U4 L8	U4 L9	U4 L11	U4 L17	U5 L1	U5 L2	U5 L4	U5 L6	U5 L11	U5 L12	U5 L13	U5 L19	U6 L14
HSF-IF.B.5	U4 L10	U4 L11	U4 L12	U5 L8	U5 L9	U5 L11	U5 L19	U6 L6	U6 L7										
HSF-IF.B.6	U4 L7	U4 L8	U4 L9	U4 L18	U5 L10	U5 L15													
HSF-IF.C	U4 L4	U4 L12	U4 L13	U4 L14	U6 L4	U6 L6	U6 L12	U6 L15	U6 L16	U6 L17									
HSF-IF.C.7	U4 L12	U5 L8	U6 L12	U6 L13															
HSF-IF.C.7.a	U1 L10	U6 L6	U6 L7	U6 L11	U6 L13	U6 L14	U6 L15	U6 L16	U6 L17										
HSF-IF.C.7.b	U4 L12	U4 L13	U4 L14																
HSF-IF.C.7.e	U5 L9	U5 L15																	
HSF-IF.C.8	U5 L18	U6 L14																	
HSF-IF.C.9	U5 L2	U5 L6	U5 L12	U6 L14															
HSF-LE.A.1	U5 L11	U5 L19	U5 L21																
HSF-LE.A.1.a	U5 L20																		
HSF-LE.A.1.b	U5 L20	U5 L21																	
HSF-LE.A.1.c	U5 L11	U5 L21																	
HSF-LE.A.2	U5 L8	U5 L9	U5 L11	U5 L13	U5 L15	U5 L19	U5 L20	U5 L21	U6 L12										
HSF-LE.A.3	U5 L1	U5 L19	U6 L4																
HSF-LE.B.5	U5 L3	U5 L4	U5 L5	U5 L11	U5 L12	U5 L13													
HSN-Q.A.1	U5 L7	U5 L8	U5 L11																

HSN-Q.A.2	U1 L1	U3 L9	U5 L17																
HSN-Q.A.3	U2 L6	U5 L11	U5 L21																
HSS-ID.B.5	U2 L1	U2 L2	U2 L3																
HSS-ID.B.6	U2 L4	U2 L7	U2 L8	U2 L9	U2 L10														
HSS-ID.B.6.a	U2 L4	U2 L6	U2 L8	U4 L17	U4 L18	U5 L11	U5 L21												
HSS-ID.B.6.b	U2 L6																		
HSS-ID.B.6.c	U2 L5	U2 L6	U4 L17	U4 L18															
HSS-ID.C.7	U2 L4	U2 L5	U2 L8	U2 L10															
HSS-ID.C.8	U2 L7	U2 L8	U2 L10																
HSS-ID.C.9	U2 L9	U2 L10																	

Unit Links

Unit 1: Linear Equations and Systems (iM Unit 2)
Unit 2: Two-Variable Statistics (iM Unit 3)
Unit 3: Linear Inequalities and Systems (iM Unit 4)
Unit 4: Functions (iM Unit 5)
Unit 5: Introduction to Exponential Functions (iM Unit 6)
Unit 6: Introduction to Quadratic Functions (iM Unit 7)

<table>
<tr><td colspan="2">Unit Title:</td></tr>
<tr><td colspan="2">Unit 1: Linear Equations and Systems (iM Unit 2)</td></tr>
<tr><td colspan="2">Relevant Standards: Bold indicates priority</td></tr>
<tr><td colspan="2">HSA-CED.A.2
HSA-CED.A.3
HSA-CED.A.4

HSA-REI.A
HSA-REI.A.1
HSA-REI.B.3
HSA-REI.C
HSA-REI.C.5
HSA-REI.C.6
HSA-REI.D.10

HSF-BF.A.1.b

HSF-IF.C.7.a

HSN-Q.A.2</td></tr>
<tr><td>Essential Question(s):</td><td>Enduring Understanding(s):</td></tr>
<tr><td>• How can we create equations to represent real-world situations?
• How do the properties of equality and inequality help us solve and justify solutions to equations?
• What does it mean for an equation or system to have one, infinite, or no solutions?
• How can the structure of an algebraic expression help us simplify and interpret it?
• What are the advantages of solving systems of equations graphically versus algebraically?
• How do the properties of numbers influence how we analyze and solve equations?
• What is a solution and how can we find them?
• What does it mean for two equations or systems to be equivalent?</td><td>• Mathematical models help us represent and analyze real-world situations.
• The structure of an equation or expression provides insight into its meaning and solution.
• Solving equations and systems of equations requires an understanding of equality and reasoning.
• The number and type of solutions to an equation or system provide important information about relationships.
• Using precise reasoning and mathematical properties ensures valid conclusions.
• A solution is a set of values that satisfies an equation or system, and various methods—such as substitution, elimination, or graphing—help us uncover these values.
• Transforming equations into other equivalent equations can help to find solutions or isolate a particular variable.
• Graphs are visualizations of the solution set to an equation or system of equations.</td></tr>
<tr><td>Demonstration of Learning:</td><td>Pacing for Unit</td></tr>
<tr><td>Section A Checkpoint
Section B Checkpoint
Section C Checkpoint
End-of-Unit Assessment</td><td>iM v.360 Pacing and Vertical Content Alignment (gr. 6-11)</td></tr>
<tr><td>Family Overview (link below)</td><td>Integration of Technology:</td></tr>
<tr><td>https://accessim.org/9-12-aga/algebra-1/unit-2?a=family</td><td></td></tr>
<tr><td>Unit-specific Vocabulary:</td><td>Aligned Unit Materials, Resources, and Technology (beyond core resources):</td></tr>
<tr><td>constraint, model, equivalent equations, solution to a system of equations, system of equations, substitution, elimination, equivalent systems</td><td></td></tr>
<tr><td>Opportunities for Interdisciplinary Connections:</td><td>Anticipated misconceptions:</td></tr>
<tr><td>Science (Physics & Biology)
• Speed & Acceleration: Writing and solving equations to analyze motion, such as car speeds or running distances.
• Population Growth: Using exponential functions to model bacteria growth or human population changes.
Health & PE
• Exercise & Heart Rate Zones: Using inequalities to determine safe heart rate ranges during workouts.
• Calories & Nutrition: Writing equations to analyze food</td><td>• Students struggle to correctly define variables and set up equations from word problems.
• Students assume every equation has a single solution and do not recognize no-solution or infinite-solution cases.
• Students believe expressions can be solved like equations, failing to differentiate between simplifying and solving.
• Students do not recognize parallel lines as systems with no solution or identical lines as having infinitely</td></tr>
</table>

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<tr>
<td>intake and energy burned.
Business & Financial Literacy
Loan & Interest Calculations: Using exponential equations to model credit card interest and loan payments.
Computer Science
Coding Basics: Using algebraic expressions in simple coding projects (e.g., game design or automation).</td>
<td>many solutions.
Students view the equal sign procedurally rather than as a statement of equivalence between two expressions.
Students often fail to realize they have solved for a variable if they do not get a numerical answer.</td>
</tr>
<tr>
<th>Connections to Prior Units:</th>
<th>Connections to Future Units:</th>
</tr>
<tr>
<td>The 8th-grade math curriculum lays the foundation for Algebra 1 by introducing students to linear equations, functions, systems of equations, inequalities, and exponents.</td>
<td>Connection to Unit 2: Two-Variable Statistics
Linear equations from Unit 1 become the basis for linear regression models
Understanding slope and y-intercept helps students interpret correlation and line of best fit
Graphing linear equations prepares students to analyze scatter plots and residuals
Connection to Unit 3: Linear Inequalities and Systems
Methods for solving equations extend to solving inequalities
Understanding solution sets of equations prepares students for solution regions of inequalities
System solving strategies adapt to systems of inequalities
Connection to Unit 4: Functions
Linear equations serve as the first and simplest example of functions
Input-output relationships in equations become function notation
Graphing skills extend to analyzing key features of all functions
Connection to Unit 5: Exponential Functions
Linear growth (constant rate) contrasts with exponential growth (constant ratio)
Understanding rate of change helps distinguish linear vs. exponential relationships
Equation solving strategies adapt to exponential equations
Connection to Unit 6: Quadratic Functions
Linear terms appear within quadratic expressions
Understanding how to rewrite linear expressions helps with factoring quadratics
Graphing skills extend to parabolas, with linear functions as a simpler case</td>
</tr>
<tr>
<th colspan="2">Differentiation through <u>Universal Design for Learning</u></th>
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<tr>
<th>UDL Indicator</th>
<th>Teacher Actions:</th>
</tr>
<tr>
<td colspan="2">Engagement
Notice and Wonder
Think-Pair-Share
Representation
Presents concepts through graphs, tables, and equations
Connects visual and symbolic representations
Supports pattern recognition across forms
Action and Expression
Which One Doesn't Belong?
Group Problem Solving
Offers choice in solution methods
Provides opportunities for different forms of expression
Supports executive function through structured collaboration
Specific Unit 1 Applications
Planning a Party (Lesson 1): Multiple entry points for modeling with equations</td>
</tr>
</table>

• Writing Equations (Lessons 2-3): Various representations of relationships • Connecting Equations to Graphs (Lessons 10-11): Visual and algebraic approaches • Solving Systems (Lessons 13-16): Multiple solution methods offered

Supporting Multilingual/English Learners
The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners: * MLR1: *Stronger and Clearer Each Time* - Students revise and refine their mathematical language through multiple drafts MLR2: *Collect and Display* - Students capture and organize language in visual displays * MLR3: *Clarify, Critique, Correct* - Students analyze mathematical writing/talk MLR4: *Information Gap* - Students share information to solve problems MLR5: *Co-Craft Questions* - Students create and improve questions * MLR6: *Three Reads* - Students analyze complex mathematical text MLR7: *Compare and Connect* - Students connect different mathematical representations * MLR8: *Discussion Supports* - Students participate in mathematical discussions MLR1: Stronger and Clearer Each Time Used in "Writing Equations to Model Relationships" lessons: Students revise and refine their mathematical explanations of relationships and patterns Key Activity: Students describe patterns in tables and refine their explanations through discussion MLR3: Clarify, Critique, Correct Featured in "Planning a Party" lesson: Students analyze constraints and equations Key Activity: Evaluating assumptions and mathematical models MLR6: Three Reads Implemented in word problems throughout the unit: Helps students break down complex modeling situations Key Activity: Reading word problems multiple times with different focuses (context, quantities, relationships) MLR8: Discussion Supports Used in lessons like "Writing Equations to Model Relationships": Supports mathematical discourse about patterns and relationships Key Activity: Structured discussions about generalizing patterns from tables

Related *CELP standards:*	**Learning Targets:**
A MLL can . . . determine the meaning of words and phrases in oral presentations and literary and informational text. **Learning Target:** I can represent real-world constraints with systems of equations and use substitution and elimination to find equivalent systems and their solutions. • **Level 1:** I can recognize simple equations and pictures that show how real-world limits work. • **Level 2:** I can match keywords and symbols to parts of simple systems of equations that model everyday problems, with support. • **Level 3:** I can create basic systems of equations from real-world examples and use guided steps with substitution or elimination to find solutions. • **Level 4:** I can model real-world constraints by writing systems of equations and use substitution and elimination to solve for equivalent systems and their solutions, explaining my steps. • **Level 5:** I can independently represent real-world constraints as systems of equations and use substitution and elimination to derive equivalent systems and determine their solutions, clearly explaining my reasoning.	

Lesson Sequence	**Learning Target**	**Success Criteria/Assessment**
Section A: Writing and Modeling with Equations Lesson 1-5	• I can interpret solutions to equations in one variable and in two variables. • I can recognize that the graph of a linear equation in two variables represents all pairs of values that are solutions to the equation. • I can write equations with numbers and variables to describe relationships and constraints.	Lessons 1-2: • I can explain the meaning of the term "constraints." • I can tell which quantities in a situation can vary and which ones cannot. Checkpoint A Problem 1 End of Unit Problem 4 *NOTES: End of Unit Problem 4* *Consider changing to a different scenario.* *Idea: Although you can buy an "8in" pizza, the cost structure is not "per inch" in real pizza shops.* *Option 1: Their experience buying pizza is sm, med, lg. Change the verbage to sm, med, lg* *Option 2: Change the scenario to something where the cost structure is per inch* *Note: IM may be including the number 8 to see if students use that value in their calculations. We*

		can still include extra, irrelevant numerical information in the new scenario. • I can use letters and numbers to write expressions representing the quantities in a situation. Checkpoint A Problem 1 Lesson 3: • I can use words and equations to describe the patterns I see in a table of values or in a set of calculations. • When given a description of a situation, I can use representations like diagrams and tables to help make sense of the situation and write equations for it. Lesson 4: • I can explain what it means for a value or pair of values to be a solution to an equation. • I can find solutions to equations by reasoning about a situation or by using algebra. Lesson 5: • I can use graphing technology to graph linear equations and identify solutions to the equations. • I can explain how the coordinates of the points on the graph of a linear equation are related to the equation. • When given the graph of a linear equation, I can explain the meaning of the points on the graph in terms of the situation it represents. Checkpoint A Problem 2
Section B: Manipulating Equations and Understanding Their Structure Lessons 8-11	• I can determine the slope and vertical intercept of the graphs of linear equations by making use of structure or by rearranging the equations. • I can rearrange multi-variable equations to highlight a particular quantity. • I can recognize that "equivalent equations" are equations that have exactly the same solutions, and that multiple equivalent equations can represent the same relationship.	Lesson 6: • I can tell whether two expressions are equivalent and explain why or why not. Checkpoint B Problem 1 End of Unit Problem 1 *NOTES: End of Unit Problem 1* *Many students are unable to demonstrate that they understand legal moves because of the complexity of fractions.* *Idea: Would prefer a similar question with different equations so students can show they know what equivalent equations mean. Compare with Checkpoint B problem 1.* • I know and can identify the moves that can be made to transform an equation into an equivalent one. • I can explain what it means for two equations to be equivalent, and how equivalent equations can be used to describe the same situation in different ways. Lesson 7: • I can explain why some algebraic moves create equivalent equations but some do not. • I know how equivalent equations are related to the steps of solving equations. • I know what it means for an equation to have no solutions and can recognize such an equation. Lesson 8:

		• Given an equation, I can solve for a particular variable (like height, time, or length) when the equation would be more useful in that form. Checkpoint B Problem 2 End of Unit Problem 2 • I know the meaning of the phrase "to solve for a variable." Lesson 9: • I can write an equation to describe a situation that involves multiple quantities whose values are not known, and then solve the equation for a particular variable. Checkpoint B Problem 2 End of Unit Problem 2 • I know how solving for a variable can be used to quickly calculate the values of that variable. Lesson 10: • I can describe the connections between an equation of the form ax + by = c, the features of its graph, and the rate of change in the situation. Checkpoint B Problem 2 End of Unit Problem 3 *NOTES: End of Unit Problem 3* *For options 'c' and 'd"* *This concept of "If we increase x by a then we must decrease y by b" does not correspond to any activity in the unit. The closest is lesson 10 activity 2 in which slope is discussed as the change in y when x changes by 1, but this is not the same.* *Idea: This could be resolved by inserting extra practice problems or an activity about the change in y value for changes in x value greater than 1 in Lesson 10.* • I can graph a linear equation of the form ax + by = c • I explain how rewriting the equation for a line in different forms can make it easier to find certain kinds of information about the relationship and about the graph. Lesson 11: • I can find the slope and vertical intercept of a line with equation ax + by = c Checkpoint B Problem C • I can take an equation of the form ax + by = c and rearrange it into the equivalent form y = mx + b • I can use a variety of strategies to find the slope and vertical intercept of the graph of a linear equation given in different forms.
Section C: Systems of Linear Equations in Two Variables Lessons 12-17	• I can determine whether a system of equations will have 0, 1, or infinitely many solutions by analyzing their structure or by graphing. • I can use elimination or substitution to create one or more equivalent systems to help solve the original system.	Lesson 12: • I can explain what we mean by "the solution to a system of linear equations" and can explain how the solution is represented graphically. • I can explain what we mean when we refer to two equations as a system of equations. • I can use tables and graphs to solve systems of equations. End of Unit Problem 5 *NOTES: End of Unit Problem 5*

		The success criterion is recognizing that the solution is the intersection, but this question assumes fluency in graphing lines in multiple forms with mixed fractions, which is not possible to do on Edulastic/Pear Assessment. *Idea: (1) Allow graphing calculator on End of Unit (2) Change the equations so that the intercepts and the solution are all whole numbers. This would also make it graphable on Pear Assessment, allowing us to track student understanding year over year.* *For example, this system has the same complexity and is graphable on edulastic.* *y=-12x+9 5x - 4y = 20 Sol: (8, 2)* Lesson 13: • I can solve systems of equations by substituting a variable or an expression. • I know more than one way to perform substitution and can decide which way or what to substitute based on how the given equations are written. End of Unit Problem 6 *NOTES: End of Unit Problem 6* *A student who has mastered elimination and substitution but has not mastered rearranging an equation first will not be able to demonstrate their learning and would receive no credit.* *Idea: (1) Separate into two questions, one where they need to rearrange (just rearrange, not solve) and then a second question where they are given one question in y=mx+b form and one in standard form.* Lesson 14: • I can solve systems of equations by adding or subtracting them to eliminate a variable. • I know that adding or subtracting equations in a system creates a new equation, where one of the solutions to this equation is the solution to the system. End of Unit Problem 7 *NOTES: End of Unit Problem 7* *The language is not accessible for many students* *Idea: Change the question so that students solve it first (this way they are demonstrating the ability to use both substitution and elimination on the test), keep part A, drop part B* Lesson 15: • I can explain why adding or subtracting two equations that share a solution results in a new equation that also shares the same solution. End of Unit Problem 7 Lesson 16: • I can solve systems of equations by multiplying each side of one or both equations by a factor, then adding or subtracting the equations to eliminate a variable. Checkpoint C Problem 1 End of Unit Problem 6 • I can explain why multiplying each side of an equation by a factor creates an equivalent

		equation whose graph and solutions are the same as that of the original equation. Lesson 17: • I can tell how many solutions a system has by graphing the equations or by analyzing the parts of the equations and considering how they affect the features of the graphs. Checkpoint C Problem 2 • I know the possibilities for the number of solutions a system of equations could have.
Section D: Let's Put it to Work Lessons 18-19		Lesson 18: • I can get more information about a problem in order to write and solve a system of linear equations. Lesson 19: • I can solve linear equations algebraically. • I can write linear equations to create a pattern.

Unit Title:	
Unit 2: Two-Variable Statistics ([iM Unit 3])	
Relevant Standards: Bold indicates priority	
HSN-Q.A.3 HSS-ID.B.5 HSS-ID.C.7 HSS-ID.C.8 HSS-ID.C.9 HSS-ID.B.6 HSS-ID.B.6.a HSS-ID.B.6.b HSS-ID.B.6.c	
Essential Question(s):	**Enduring Understanding(s):**
• How can I summarize and interpret categorical data from two-way frequency tables to identify trends and possible associations between groups? • How do I create a scatter plot for two quantitative variables and describe the type and strength of their relationship? • How can I choose an appropriate function (linear, quadratic, or exponential) to fit a set of data and use that model to solve problems in a real-world context? • How can we use a statistical model to make predictions, and to what extent can we trust those predictions? • What does the slope and intercept of a linear model reveal about the rate of change and starting point in the context of the data? • What does a correlation coefficient say about the relationship between two variables? • What is the relationship between correlation and causation?	• Two-way frequency tables organize data into joint, marginal, and conditional frequencies to reveal patterns and associations between categories. • Scatter plots display the relationship between two quantitative variables, highlighting the type, direction, and strength of their association. • Linear, quadratic, or exponential functions can be selected to model real-world data, enabling predictions and problem-solving in context. • Plotting residuals helps identify how well a chosen function fits the data and exposes any discrepancies or patterns not captured by the model. • The slope represents the rate of change between variables, while the intercept indicates the starting point, both of which are essential for understanding the model's real-world meaning. • The correlation coefficient quantifies the strength and direction of a linear relationship, but it is crucial to remember that correlation does not imply causation.
Demonstration of Learning:	**Pacing for Unit**
Section A Checkpoint Section B Checkpoint *NOTE: Consider adding a question involving finding the line of best fit using technology and making a prediction using the equation.* Section C Checkpoint End-of-Unit Assessment *NOTE: If lesson on residuals is skipped, remove question 1 and question 7 part A from the End of Unit and skip Checkpoint B part 2.*	[iM v.360 Pacing and Vertical Content Alignment (gr. 6-11)]
Family Overview (link below)	**Integration of Technology:**
https://accessim.org/9-12-aga/algebra-1/unit-3?a=family	
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
categorical variable, two-way table, variable (statistics), relative frequency table, association, residual, correlation coefficient, negative relationship, positive relationship, strong relationship, weak relationship, causal relationship	
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
Social Studies & Civic Engagement • Use two-way tables and relative frequency tables to	• Many students think all variables are numerical or naturally ordered, not recognizing that categorical

analyze survey data from community or school elections. Students can explore associations between categorical variables (such as voter age groups or political affiliation) and examine the strength of relationships using the correlation coefficient. Sports Analytics • Analyze team or player performance data by creating two-way tables that compare categorical variables like player position or team division with performance metrics (e.g., win/loss records, points scored). Students can calculate relative frequencies and use the correlation coefficient to examine relationships. Technology and Social Media • Use survey data about social media usage to explore relationships between categorical variables such as preferred platform (Instagram, Twitter, etc.) and usage frequency. Create two-way tables and relative frequency tables to analyze associations and compute correlation coefficients.	(nominal) data simply labels groups. • Students can get confused if one table has a total and another does not or may try to apply strategies they learned for totals on a table that does not have totals. • Students may treat relative frequencies as raw counts instead of proportions or percentages. • Students may have trouble distinguishing between the observed data and the output predicted by the line of best fit. • Some believe a coefficient of 0 means no relationship at all, that a high correlation implies causation, or that a negative correlation coefficient represents a weaker correlation than 0. • Some believe that a higher slope implies a stronger correlation or a higher correlation coefficient. • A common error is believing that correlation directly implies causation without considering other factors. • Many students draw lines of best fit to either always start from the origin or always go through the first and last points. They may also believe a line of best fit should go through as many points as possible, even curving the line to achieve this.
Connections to Prior Units:	**Connections to Future Units:**
Two-variable statistics and linear equations are deeply connected because both focus on understanding and modeling relationships between variables. For instance, when you plot paired data on a scatter plot, you often use a linear equation (like $y = mx + b$) to represent the trend in the data. In a line of best fit, slope m and intercept b explain how one variable changes with respect to the other. This connection allows us to predict values and analyze the strength and direction of relationships in real-world data. There is emphasis on interpreting y-intercept and slope in the context of the problem, which students have seen in the previous unit and 8th grade.	Connection to Unit 3: Linear Inequalities and Systems • Understanding constraints in data helps interpret inequality boundaries • Analyzing scatter plots prepares students to visualize feasible regions • Interpreting points above/below a line extends to understanding solution regions Connection to Unit 4: Functions • Correlation and causation discussions prepare for understanding functional relationships • Analyzing relationships in data sets leads to formal function concepts • Interpreting key features of scatter plots extends to analyzing function graphs Connection to Unit 5: Exponential Functions • Residual analysis helps distinguish linear from exponential patterns • Understanding "goodness of fit" helps choose appropriate models • Data analysis skills extend to exploring exponential relationships Connection to Unit 6: Quadratic Functions • Pattern recognition in data prepares for identifying quadratic relationships • Understanding that not all relationships are linear prepares for quadratic modeling • Analyzing curved patterns in data extends to parabolic relationships
Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**
Engagement • Card Sort Activities • Statistical Investigations • Data Visualization • Statistical Language Routines • Builds understanding of statistical vocabulary	

- Uses everyday language to explain statistical concepts
- Provides structured ways to discuss relationships in data

Action and Expression

- Data Analysis Protocols

Specific Unit 2 Applications

- Two-Way Tables (Lessons 1-3): Multiple ways to organize and analyze categorical data
- Linear Models (Lessons 4-6): Visual and numerical approaches to understanding relationships
- Correlation (Lessons 7-8): Various methods to analyze strength of relationships
- Causation (Lesson 9): Multiple contexts for understanding statistical relationships

Supporting Multilingual/English Learners

The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners:

MLR1: *Stronger and Clearer Each Time* - Students revise and refine their mathematical language through multiple drafts
* MLR2: *Collect and Display* - Students capture and organize language in visual displays
MLR3: *Clarify, Critique, Correct* - Students analyze mathematical writing/talk
* MLR4: *Information Gap* - Students share information to solve problems
MLR5: *Co-Craft Questions* - Students create and improve questions
MLR6: *Three Reads* - Students analyze complex mathematical text
* MLR7: *Compare and Connect* - Students connect different mathematical representations
* MLR8: *Discussion Supports* - Students participate in mathematical discussions

MLR4: Information Gap
Featured prominently in "Two-Way Tables" lesson: Students share information to complete and interpret tables
Key Activity: Partners work together to complete missing information in two-way tables

MLR2: Collect and Display
Used throughout the unit for organizing statistical data: Students create and interpret different data displays
Key Activity: Converting between frequency tables and relative frequency tables

MLR7: Compare and Connect
Applied when comparing different representations of data: Students connect tables, graphs, and written descriptions
Key Activity: Analyzing associations between variables using different representations

MLR8: Discussion Supports
Implemented in lessons like "Associations in Categorical Data": Structures discussions about statistical relationships
Key Activity: Discussing patterns and relationships in data using precise statistical language

Related CELP standards:	**Learning Targets:**

A MLL can . . . determine the meaning of words and phrases in oral presentations and literary and informational text.
Learning Target: I can organize data using two-way and relative frequency tables, analyze associations with correlation coefficients, and describe whether relationships are positive, negative, strong, or weak while understanding that correlation does not imply causation.

- **Level 1:** I can recognize and label basic parts of data tables and graphs, such as rows, columns, and simple symbols.
- **Level 2:** I can match keywords like “categorical variable,” “two-way table,” and “relative frequency” with simple examples using visuals and word banks.
- **Level 3:** I can organize data into two-way and relative frequency tables and describe basic associations between variables with support.
- **Level 4:** I can analyze and interpret data by calculating correlation coefficients and explain if relationships are positive, negative, strong, or weak using clear examples.
- **Level 5:** I can independently organize data with two-way and relative frequency tables, analyze associations using correlation coefficients, and distinguish between positive, negative, strong, and weak relationships while understanding that correlation does not imply causation.

Lesson Sequence	Learning Target	Success Criteria/Assessment
Section A: Two-Way Tables Lessons 1-3	• I can create relative frequency tables from information given in a two-way table or about a situation. • I can inspect patterns in relative frequency tables and	Lesson 1: • I can calculate missing values in a two-way table. • I can create a two-way table for categorical data given information about a situation. • I can describe what the values in a two-way table mean in the context of the situation.

	two-way tables to determine if there is a possible association between two variables of interest.	Checkpoint A Problem 1 End of Unit Problem 5 Lesson 2: • I can calculate values in a relative frequency table and describe what the values mean in everyday language. Lesson 3: • I can look for patterns in two-way tables and relative frequency tables to see if there is a possible association between two variables. End of Unit Problem 6
Section B: Scatter Plots Lessons 4-6	• I can comprehend the connection between residuals, variability, and whether or not using a linear model is appropriate. • I can interpret the rate of change and vertical intercept for a linear model in the context of a situation.	Lesson 4: • I can describe the rate of change and y-intercept for a linear model that represents a situation. Checkpoint B Problem 1 • I can draw a linear model that fits the data well and use the linear model to estimate values I want to find. Lesson 5: • I can describe the rate of change and y-intercept for a linear model that represents a situation. Checkpoint B End of Unit Problem 3 • I can use technology to find the line of best fit. Lesson 6 (Optional): • I can plot and calculate residuals for a data set and use the information to judge whether a linear model is a good fit.
Section C: Correlation Coefficients Lessons 7-9	• I can describe the strength and sign of the relationship between variables based on the correlation coefficient. • I can investigate the relationship between two variables to analyze whether or not the relationship is causal.	Lesson 7: • I can describe the goodness of fit of a linear model using the correlation coefficient. End of Unit Problem 2 • I can match the correlation coefficient with a scatter plot and linear model. End of Unit Problem 2 Lesson 8: • I can describe the strength of a relationship between two variables. Checkpoint C • I can use technology to find the correlation coefficient and explain what the value tells me about a linear model that represents a situation. Lesson 9: • I can look for connections between two variables to analyze whether or not there is a causal relationship End of Unit Problem 4

Unit Title:	
Unit 3: Linear Inequalities and Systems [(iM Unit 4)]	
Relevant Standards: Bold indicates priority	
HSA-CED.A.1 HSA-CED.A.3 HSA-REI.B.3 HSA-REI.D.12 HSA-REI.D.10 HSN-Q.A.2	
Essential Question(s):	**Enduring Understanding(s):**
• How can I create equations and inequalities to represent real-world situations? • In what ways do the solutions of equations and inequalities help us understand and solve problems in context? • What strategies can I use to solve linear equations and inequalities, including those with lettered coefficients, and how do I choose the best one? • How do I find and represent a solution set?	• Equations and inequalities serve as powerful models that represent real-world situations by translating constraints and relationships into a mathematical language. • Solving equations and inequalities in one variable means finding all values that satisfy the given condition, whether through methods like balancing, substitution, or graphing. • Mathematical solutions must be interpreted in light of the original problem, ensuring that the answer is meaningful and accurately reflects the real-world scenario. • Clear reasoning and communication in creating, solving, and interpreting equations and inequalities form the basis for effective problem solving and informed decision-making in real-world contexts. • Inequalities can be defined by their boundary and the region (relative to the boundary) that contains the solution set. This extends both to solving and to graphing one- and two-variable inequalities. • Solution set of systems of inequalities in two variables is composed of any pair of values that make both inequalities true.
Demonstration of Learning:	**Pacing for Unit**
Section A Checkpoint Section B Checkpoint Section C Checkpoint End-of-Unit Assessment	iM v.360 Pacing and Vertical Content Alignment (gr. 6-11)
Family Overview (link below)	**Integration of Technology:**
https://accessim.org/9-12-aga/algebra-1/unit-4?a=family	
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
solutions to a system of inequalities, system of inequalities	
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
Science (Physics) • Students model linear motion by writing an equation for the distance traveled over time using real-world speed and time data. • Apply Newton's Second Law by setting up and solving equations to analyze force, mass, and acceleration in different scenarios. • Phase diagrams in chemistry are systems of linear inequalities. (future grade levels) Social Studies • Students create a monthly budget by writing equations	• Many students believe the direction of the inequality sign (< or >) will always be the same after solving or rearranging the inequality. • Students often misread word problems, overlook key constraints, or choose inappropriate variables, leading to incomplete or incorrect equations. • Students may follow rote steps without understanding inverse operations, causing errors in maintaining equivalence. • Students often expect a single point solution instead

and inequalities for income, expenses, and savings. • Analyze break-even points for small businesses using a system of equations to compare revenue and costs. • Use supply and demand models to explore real-world pricing and economic decision-making. Health & PE • Students track their daily caloric intake and exercise expenditure by writing equations to model energy balance. • Compare different diet plans and workout regimens using a system of equations to determine optimal nutrition. • Create inequalities to determine if a person meets nutritional guidelines while staying within calorie limits.	of a region (often on the intersection of the boundaries), mix up open/closed boundaries, or misinterpret "and" vs. "or," leading to errors in graphing feasible regions. • Some students believe that a number is not a solution to an inclusive inequality if the numbers are not equal. • Many students interpret "at least" to mean "less than" and "at most" to mean "more than" when in fact it is the opposite.
Connections to Prior Units:	**Connections to Future Units:**
The unit builds on concepts from middle school when students write and solve inequalities by reasoning about quantities, particularly in using a number line to solve or represent one-variable inequalities from 8th grade. It further builds on concepts from an earlier unit in which students solve linear equations and systems of equations by writing equivalent equations. The unit assumes fluency in graphing linear equations and systems of linear equations. The unit extends the definition of solutions from unit 2.	Connection to Unit 3: Linear Inequalities and Systems • Understanding constraints in data helps interpret inequality boundaries • Analyzing scatter plots prepares students to visualize feasible regions • Interpreting points above/below a line extends to understanding solution regions Connection to Unit 4: Functions • Correlation and causation discussions prepare for understanding functional relationships • Analyzing relationships in data sets leads to formal function concepts • Interpreting key features of scatter plots extends to analyzing function graphs Connection to Unit 5: Exponential Functions • Residual analysis helps distinguish linear from exponential patterns • Understanding "goodness of fit" helps choose appropriate models • Data analysis skills extend to exploring exponential relationships Connection to Unit 6: Quadratic Functions • Pattern recognition in data prepares for identifying quadratic relationships • Understanding that not all relationships are linear prepares for quadratic modeling • Skill Transfer: extends to parabolic relationships
Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**

Engagement

- Context-Rich Problems
- Visual Learning Activities
    - Uses shading and graphing to represent solutions
    - Incorporates physical movement to understand greater than/less than
    - Employs number lines and coordinate planes for visualization

Representation

- Multiple Representations of Inequalities
    - Presents concepts through words, symbols, graphs, and regions
    - Uses number lines and coordinate planes for visualization
    - Connects algebraic and geometric representations
- Inequality Language Routines
    - Builds precise mathematical language for inequalities
    - Connects everyday comparisons to mathematical notation
    - Provides structured ways to describe solution regions

Action and Expression

- Solution Strategy Options

- Technology Integration
  - Uses graphing technology to explore solutions
  - Supports visualization of solution regions
  - Enables efficient testing of multiple points

Specific Unit 3 Applications

- One-Variable Inequalities (Lessons 1-3)
  - Multiple representations of solution sets
  - Various contexts for constraints
  - Different approaches to testing solutions
- Two-Variable Inequalities (Lessons 4-6)
  - Visual and algebraic approaches to solutions
  - Multiple methods for determining shading
  - Real-world applications of boundaries
- Systems of Inequalities (Lessons 7-9)
  - Various strategies for finding overlap regions
  - Multiple contexts for systems
  - Different approaches to optimization

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MLR4: *Information Gap* - Students share information to solve problems
MLR5: *Co-Craft Questions* - Students create and improve questions
* MLR6: *Three Reads* - Students analyze complex mathematical text
MLR7: *Compare and Connect* - Students connect different mathematical representations
MLR8: *Discussion Supports* - Students participate in mathematical discussions

MLR1: Stronger and Clearer Each Time
Used when students refine explanations of solution strategies
Helps students articulate reasoning about inequalities

MLR3: Clarify, Critique, Correct
Applied when analyzing solution methods
Students evaluate different approaches to solving systems

MLR6: Three Reads
Used for word problems involving constraints
Helps break down contextual inequality problems

Related *CELP standards:*	**Learning Targets:**

A MLL can . . . determine the meaning of words and phrases in oral presentations and literary and informational text.

Learning Target: I can create, solve, and interpret equations and inequalities using multiple methods, ensuring solutions are meaningful in context and accurately represented graphically.

- **Level 1:** I can use words, symbols, and visuals to show how to set up and solve simple equations and inequalities with support.
- **Level 2:** I can create and solve basic equations and inequalities with models, sentence frames, and guided examples, and explain my answer using key vocabulary.
- **Level 3:** I can write, solve, and graph equations and inequalities using different methods, and explain how my solution relates to the problem with some support.
- **Level 4:** I can create, solve, and interpret equations and inequalities in different forms, explain my reasoning clearly, and connect my solution to real-world situations.
- **Level 5:** I can fluently create, solve, and analyze equations and inequalities using multiple strategies, justify my solutions in written and verbal explanations, and apply them to real-world problems.

Lesson Sequence	Learning Target	Success Criteria/ Assessment
Section A: Linear Inequalities in One Variable Lessons 1-3	• I can use a related equation to solve an inequality in one variable. • I can write and solve inequalities in one variable to represent the constraints in situations and to	Lesson 1: • I can write inequalities that represent the constraints in a situation. Checkpoint A Problem 1 End of Unit Problem 2 Lesson 2:

	solve problems. If time allows, Add an activity/lesson on compound inequalities so that students are prepared when they use them in piecewise functions.	• I can graph the solution to an inequality in one variable. Checkpoint A Problem 1 • I can solve one-variable inequalities and interpret the solutions in terms of the situation. Checkpoint A Problem 2 End of Unit Problem 1 *NOTE End of Unit Problem 1* *Students get this wrong because they struggle with PEMDAS / inputting values into the calculator when substituting into the inequality* End of Unit Problem 6 • I can explain why the solution to an inequality is a range of values (such as x > 7) that makes the inequality true. Lesson 3: • I can analyze the structure of an inequality in one variable to help determine if the solution is greater or less than the solution to the related equation. • I can write and solve inequalities to answer questions about a situation.
Section B: Linear Inequalities in Two Variables Lessons 4-6	• I can understand that a constraint on two variables can be represented by an inequality, a graph (a half-plane), and a verbal description. • I can write inequalities in two variables to represent the constraints in a situation, and use technology to graph the solution set to answer questions about the situation.	Lesson 4: • Given a two-variable inequality and the graph of the related equation, I can determine on which side of the line the solutions to the inequality will fall. • I can describe the graph that represents the solutions to a linear inequality in two variables. Checkpoint B Problem 1 Lesson 5: • Given a two-variable inequality that represents a situation, I can interpret points in the coordinate plane and decide if they are solutions to the inequality. End of Unit Problem 4 • I can find the solutions to a two-variable inequality by using the graph of a related two-variable equation. End of Unit Problem 4 Checkpoint B Problem 2 • I can write inequalities to describe the constraints in a situation. Lesson 6: • I can use graphing technology to find the solution to a two-variable inequality. • When given inequalities, graphs, and descriptions that represent the constraints in a situation, I can connect the different representations and interpret them in terms of the situation.
Section C: Systems of Linear Inequalities in Two Variables Lessons 7-9	• I can, given a system of inequalities and their graphs, explain how to tell if a pair of values is a solution to the system. • I can understand that the solution set of a system of	Lesson 7: • I can write a system of inequalities to describe a situation, find the solution by graphing, and interpret points in the solution. Checkpoint C problem 2 End of Unit Problem 7 • I know what is meant by "the solutions to a

	inequalities in two variables is composed of any pair of values that make both inequalities true, and that it is represented graphically by the region where the graphs overlap.	system of inequalities" and can describe the graphs that represent the solutions. Checkpoint C Problem 1 • When given descriptions and graphs that represent two different constraints, I can find values that satisfy each constraint individually, and values that satisfy both constraints at once. End of Unit Problem 3 End of Unit Problem 5 Lesson 8: • I can explain how to tell if a point on the boundary of the graph of the solutions to a system of inequalities is a solution or not. Lesson 9: • I can interpret inequalities and graphs in a mathematical model. • I know how to choose variables, specify the constraints, and write inequalities to create a mathematical model. Checkpoint C Problem 2

Unit Title:	
Unit 4: Functions (iM Unit 5)	
Relevant Standards: Bold indicates priority	
HSA-CED.A.1 HSA-CED.A.4 HSA-REI.A.1 HSA-REI.D.11 HSF-BF.A.1 HSF-BF.A.1a HSF-BF.B.3 HSF-BF.B.4 HSF-BF.B.4a HSF-IF.A.1 HSF-IF.A.2 HSF-IF.B HSF-IF.B.4 HSF-IF.B.6 HSF-IF.C HSF-IF.C.7 HSF-IF.C.7.b HSS.-ID.B.6.a HSS-ID.B.6.c	
Essential Question(s):	**Enduring Understanding(s):**
• How can we use function notation, graphs, and equations to describe relationships between quantities in the real world? • What key features of a graph (like intercepts, maximums, minimums, and intervals of increase or decrease) help us understand the story a function tells? • How do we calculate and interpret the average rate of change of a function, and what does it tell us about the relationship between two quantities? • What makes a relationship a function, and how can we determine if a function has an inverse that is also a function?	• Function Notation, Graphs, and Equations: Function notation, graphs, and equations are powerful tools for describing relationships between quantities, allowing us to model real-world situations and interpret how changes in one quantity affect another. • Key Features of Graphs: The key features of a graph, such as intercepts, maximums, minimums, and intervals of increase or decrease, help us understand the behavior and story a function tells about a real-world situation, revealing how the relationship between variables changes over time or under different conditions. • Average Rate of Change: The average rate of change of a function, represented by the slope over an interval, helps us quantify how one quantity changes in relation to another and provides insight into the strength and direction of their relationship over that interval. • Function Definition and Inverses: A relationship is a function when each input corresponds to exactly one output. Understanding domain and range is essential for determining whether a function has an inverse, and whether that inverse is also a function, which allows us to solve for unknowns in different contexts. • Non-Linear Functions: Not all situations are easily represented by linear equations. Piecewise functions, step functions, and absolute value functions can be useful to represent or model a wider range of situations.
Demonstration of Learning:	**Pacing for Unit**
Checkpoint A Checkpoint B Mid-unit Assessment Checkpoint C Checkpoint D End-of-Unit Assessment	iM v.360 Pacing and Vertical Content Alignment (gr. 6-11)
Family Overview (link below)	**Integration of Technology:**
https://accessim.org/9-12-aga/algebra-1/unit-5?a=family	Desmos Graphing Calculator
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
Dependent variable, independent variable, function, function notation, linear function, maximum, minimum,	Desmos Classroom Released Activities

horizontal intercept, vertical intercept, average rate of change, domain, range, piecewise function, absolute value, vertex, inverse function	
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions:**
Science (Physical Science, Earth Science) • In physical science, students learn about speed, velocity, and acceleration—concepts that can be modeled with linear functions. Graphing these relationships helps students understand changes over time. • In physical science, students learn about using Kelvin to measure temperature and in math they learn how to use functions and their inverse to convert back and forth from kelvin and celsius. Social Studies • Functions apply to economic trends, such as tracking the relationship between minimum wage and employment rates or supply and demand. • In civics, students could use functions to model changes in voter turnout over time or the effect of policy changes. Health & PE • In PE, students could model heart rate during exercise, where different stages (rest, exercise, recovery) are modeled with a piecewise function. • Students can analyze the graph of hydration levels during a sports event and use function features (like decreasing intervals) to decide when athletes should drink water. Visual Arts and Music • Transformations of graphs (shifts, reflections, stretches) tie directly to transformations in art (moving shapes on a canvas or stretching images). Career and Technical Education • Functions are essential in business, engineering, computer science, and data analysis. • In business, students can create profit functions that model how income changes based on sales. • In computer science, students write actual functions in code to process inputs and outputs, directly connecting math to programming logic. • In construction or engineering, students can graph relationships like material costs vs. project size.	• Understanding the dependent variable (output) if a function of the independent variable (input) • Interpreting function notation in the context of a problem, especially when only the input or output is given (not both). • Understanding that function notation “f(x)” is not multiplication of two variables • Representing a word problems as a mathematical model, such as an equation in function notation • Understanding what a function or its inverse gives you within a context • Predicting future results based on the average rate of change, including understanding of it as a rate • Rewriting a function as its inverse. • Graphing a piecewise function that is not a step function
Connections to Prior Units:	**Connections to Future Units:**
In this unit, students expand and deepen their understanding of functions. They begin with a reminder of the definition of a function (a rule that assigns exactly one output to each input) that they previously saw in grade 8, then get familiar with function notation and use it to compare and analyze functions, write rules for functions, and solve for inputs or outputs.	Connection to Unit 4: Functions • Understanding domain restrictions from inequalities connects to function domains • Graphing regions above/below lines prepares for understanding piecewise functions • Interpreting solution regions builds intuition for function behavior in different intervals Connection to Unit 5: Exponential Functions • Constraints from inequalities help define meaningful domains for exponential contexts • Understanding bounded regions connects to asymptotic behavior • Solving inequalities with variables extends to exponential inequalities Connection to Unit 6: Quadratic Functions • Linear inequality concepts extend to quadratic inequalities • Understanding regions above/below lines prepares for regions above/below parabolas • Systems thinking extends to systems with quadratic functions

Differentiation through *Universal Design for Learning*	
UDL Indicator	**Teacher Actions:**

Engagement
- Real-World Connections
- Interactive Explorations
    - Incorporates dynamic graphing activities
    - Encourages investigation of function behavior
    - Allows for discovery of patterns and relationships

Representation
- Multiple Function Representations
    - Presents functions through graphs, tables, equations, and verbal descriptions
    - Uses mapping diagrams and input-output tables
    - Connects different ways of showing functional relationships
- Function Language Development
    - Introduces function notation gradually with meaning
    - Connects everyday language to mathematical notation
    - Provides structured ways to describe function behavior

Action and Expression
- Varied Analysis Methods
- Technology Tools

Specific Unit 4 Applications
- Introduction to Functions (Lessons 1-5)
    - Multiple ways to understand input-output relationships
    - Various representations of function rules
    - Gradual introduction of notation
- Analyzing Graphs (Lessons 6-9)
    - Visual and numerical approaches to features
    - Multiple methods for finding rate of change
    - Different ways to compare functions
- Domain and Range (Lessons 10-14)
    - Various contexts for understanding valid inputs/outputs
    - Multiple representations of restrictions
    - Real-world applications of domains
- Inverse Functions (Lessons 15-18)
    - Different approaches to understanding reversibility
    - Multiple methods for finding inverses
    - Various applications and contexts

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MLR5: *Co-Craft Questions* - Students create and improve questions
MLR6: *Three Reads* - Students analyze complex mathematical text
* MLR7: *Compare and Connect* - Students connect different mathematical representations
* MLR8: *Discussion Supports* - Students participate in mathematical discussions

MLR2: Collect and Display
Used to organize function notation and representations
Students create visual displays of function relationships

MLR7: Compare and Connect
Applied when connecting different function representations
Students link graphs, tables, and equations

MLR8: Discussion Supports
Structured discussions about function features
Vocabulary development for function concepts

Related *CELP standards:*	**Learning Targets:**

A MLL can...speak and write about grade-appropriate complex literary and informational texts and topics.
Learning Target: I can analyze and apply functions, including their notation, graphs, transformations, and real-world applications, to solve problems and model situations.

- **Level 1**: With prompting and supports, I can identify basic function-related words and match simple functions to graphs or real-life examples.
- **Level 2**: With prompting and supports, I can use function notation and describe basic function behaviors with support.
- **Level 3**: With guidance and supports, I can compare functions using notation and graphs, and explain their domain and range in real-world contexts.
- **Level 4**: I can write rules for functions, solve for inputs and outputs, and explain transformations with real-life examples.
- **Level 5**: I can analyze and model real-world situations with functions, including using inverses and explaining advanced features and transformations.

Lesson Sequence	Learning Target	Success Criteria/Assessment
Section A: Functions and Their Representations Lessons 1-5	• I can sketch a graph of a function given statements in function notation. • I can understand that a relationship between two quantities is a function if there is only one possible output for each input. • I can write equations that represent rules using function notation.	Lesson 1: • I can explain when a relationship between two quantities is a function. Checkpoint A Problem 1 *NOTES: Checkpoint A Problem 1* *Consider changing the scenarios to more student friendly relationship* • I can identify independent and dependent variables in a function and use words and graphs to represent the function. • I can make sense of descriptions and graphs of functions and explain what they tell us about situations. Lesson 2: • I can use function notation to express functions that have specific inputs and outputs. • I understand what function notation is and why it exists. • When given a statement written in function notation, I can explain what it means in terms of a situation. yMiddle of Unit Problem 1 Middle of Unit Problem 4 Lesson 3: • I can describe the connections between a statement in function notation and the graph of the function. Middle of Unit Problem 2 Middle of Unit Problem 5 Checkpoint B Problem 1 • I can use function notation to efficiently represent a relationship between two quantities in a situation. Checkpoint B Problem 2 *NOTE: Checkpoint B Problem 2* *Add a table/graph with values for students to calculate average rate of change, not just write an expression.* • I can use statements in function notation to sketch a graph of a function. Lesson 4: • I can make sense of rules of functions when they are written in function notation, and create tables and graphs to represent the functions.

		Middle of Unit Problem 6 • I can write equations that represent the rules of functions. Checkpoint A Problem 2 Middle of Unit Problem 4 Middle of Unit Problem 6 NOTES: Middle of Unit Problem 6 Students need more exposure to situations like this example with rice. Lesson 5: • I can use technology to graph a function given in function notation and use the graph to find the values of the function. • I know different ways to find the value of a function and to solve equations written in function notation. • I know what makes a function a linear function.
Section B: Analyzing and Creating Graphs of Functions Lessons 6-9	• I can, given a graph of a function, estimate or calculate the average rate of change over a specified interval. • I can interpret key features of a graph—the intercepts, maximums, minimums, and intervals when the function is increasing or decreasing—in terms of a situation. • I can interpret statements about two or more functions written in function notation.	Lesson 6: • I can identify important features of graphs of functions and explain what they mean in the situations represented. Middle of Unit Problem 3 • I understand and can use the terms “horizontal intercept,” “vertical intercept,” “maximum,” and “minimum” when talking about functions and their graphs. Checkpoint B Problem 1 Middle of Unit Problem 3 Lesson 7: • I understand the meaning of the term “average rate of change.” Middle of Unit Problem 7 *NOTE: Middle of Unit Problem 7* *Make Part b. one year and not an interval of years.* • When given a graph of a function, I can estimate or calculate the average rate of change between two points. Middle of Unit Problem 7 Lesson 8: • I can explain the average rate of change of a function in terms of a situation. Middle of Unit Problem 7 • I can make sense of important features of a graph and explain what they mean in a situation. • When given a description or a visual representation of a situation, I can sketch a graph that shows important features of the situation. Lesson 9: • I can compare the features of graphs of functions and explain what they mean in the situations represented. • I can make sense of an equation of the form • in terms of a situation and a graph, and know how to find the solutions.

		• I can make sense of statements about two or more functions when they are written in function notation.
Section C: A Closer Look at Inputs and Outputs Lessons 10-14	• I can interpret an absolute value function described in words or in function notation, and create a table of values and a graph to represent the function. • I can interpret the graph of a piecewise function or its rules given in function notation, and explain the rules (orally and in writing) in terms of a situation. • I understand that the domain of a function is the set of all possible inputs and the range is the set of all possible outputs.	Lesson 10: • I know what is meant by the "domain" and "range" of a function. Checkpoint C Problem 1 *NOTE: Checkpoint C Problem 1:* *At a minimum (SG), change order of questions to c, a ,b. Students do not describe domain and range of functions in the lesson, they also do not graph an absolute value function by hand without a table.* Checkpoint C Problem 2 *NOTE: Checkpoint C Problem 2* *Same issue as Problem 1. Students have not determined domain and range from a piecewise function.* End of Unit Problem 1 • When given a description of a function in a situation, I can determine a reasonable domain and range for the function. Checkpoint C Problem 1 Checkpoint C Problem 2 End of Unit Problem 1 *NOTE: End of Unit Problem 1:* *The graph is misleading to determine the range.* Lesson 11: • When given a description of a function in a situation, I can determine a reasonable domain and range for the function. Checkpoint C Problem 1 Checkpoint C Problem 2 Lesson 12: • I can make sense of a graph of a piecewise function in terms of a situation and sketch a graph of the function when the rules are given. End of Unit Problem 5 End of Unit Problem 7 NOTE: End of Unit Problem 7 Change y-axis label to Total Cost instead of Cost • I can make sense of the rules of a piecewise function when they are written in function notation and explain what they mean in the situation represented. Checkpoint C Problem 2 End of Unit Problem 5 • I understand what makes a function a piecewise function. Lesson 13: • Given a set of numerical guesses and a target number, I can calculate absolute errors and create a scatter plot of the data. End of Unit Problem 2 • I can analyze and describe features of a scatter plot that shows absolute error data. • I can describe the general relationship between

		guesses and absolute errors using words or equations. End of Unit Problem 2 Lesson 14: • I can describe the effects of adding a number to the expression that defines an absolute value function. Checkpoint C Problem 1 End of Unit Problem 3 • I can explain the meaning of absolute value function in terms of distance. • When given an absolute value function in words or in function notation, I can make sense of it and create a table of values and a graph to represent it.
Section D: Inverse Functions Lessons 15 - 17	• I can find the inverse of a linear function by solving an equation for the input variable. • I can write a linear function and an inverse function to model data and solve problems.	Lesson 15: • I understand the meaning of "inverse function" and how it could be found. Checkpoint D Problem 1 End of Unit Problem 4 • When given a linear function that represents a situation, I can use words and equations to describe the inverse function. Checkpoint C Problem 1 Lesson 16: • I can explain the meaning of an inverse function in terms of a situation. End of Unit Problem 6 • When I have an equation that defines a linear function, I know how to find its inverse. Checkpoint C Problem 1 End of Unit Problem 4 Lesson 17: • I can write a linear function to model given data and find the inverse of the function. • When given a linear function defined using function notation, I know how to find its inverse. End of Unit Problem 6
Section E: Let's Put It to Work Lesson 18	I can use functions to model real-life situations and make predictions.	I can use functions to model data and make predictions.

<table>
<tr><th colspan="2">Unit Title:</th></tr>
<tr><td colspan="2">Unit 5: Introduction to Exponential Functions (iM Unit 6)</td></tr>
<tr><th colspan="2">Relevant Standards: Bold indicates priority</th></tr>
<tr><td colspan="2">HSA-SSE.A
HSA-SSE.A.1
HSA-SSE.A.1.b
HSA-SSE.B.3.c

HSA-REI.A.1
HSA-REI.D.11

HSF-BF.A.1
HSF-BF.A.1.a

HSA-CED.A.1
HSA-CED.A.4

HSF-IF.A.2
HSF-IF.B
HSF-IF.B.4
HSF-IF.B.5
HSF-IF.B.6
HSF-IF.C
HSF-IF.C.7.b
HSF-IF.C.7.e
HSF-IF.C.8
HSF-IF.C.9

HSF-LE.A.1
HSF-LE.A.1.a
HSF-LE.A.1.b
HSF-LE.A.1.c
HSF-LE.A.2
HSF-LE.A.3
HSF-LE.B.5

HSN-Q.A.1
HSN-Q.A.3

HSS-ID.B.6.a
HSS-ID.B.6.c</td></tr>
<tr><th>Essential Question(s):</th><th>Enduring Understanding(s):</th></tr>
<tr><td>How can mathematical expressions, equations, and inequalities be used to model and solve real-world problems?
What patterns and relationships exist in different types of functions (linear and exponential), and how do their graphs represent these relationships?
How do the key features of functions (such as intercepts, domain, range, increasing/decreasing behavior) help us analyze and compare different types of functions?
How can properties of exponents be used to simplify expressions, solve equations, and model exponential growth and decay?
How can we distinguish between situations modeled by linear and exponential functions, and what real-world problems are best represented by each?</td><td>Functions describe relationships between variables and can be represented algebraically, graphically, numerically, and verbally.
Exponential functions model situations in which a number repeatedly multiplies or divides (or increases or decreases by a set percentage of the total).
The characteristics of functions, such as intercepts and growth factors, help us analyze and compare different types of functions and their real-world applications.
Patterns in different types of functions help us determine how quantities change over time and predict future values.
The structure of algebraic expressions can be analyzed and rewritten to reveal important information about functions and their graphs.
Exponential functions model real-world situations such as population growth, radioactive decay, and financial investments, and their properties can be understood through transformations and logarithmic relationships.</td></tr>
<tr><th>Demonstration of Learning:</th><th>Pacing for Unit</th></tr>
<tr><td>Section A Checkpoint
Section B Checkpoint
Mid-Unit Assessment
Section C Checkpoint
Section D Checkpoint
End-of-Unit Assessment</td><td>iM v.360 Pacing and Vertical Content Alignment (gr. 6-11)</td></tr>
<tr><th>Family Overview (link below)</th><th>Integration of Technology:</th></tr>
<tr><td>https://accessim.org/9-12-aga/algebra-1/unit-6?a=family</td><td>Desmos Graphing Technology</td></tr>
<tr><th>Unit-specific Vocabulary:</th><th>Aligned Unit Materials, Resources, and Technology (beyond core resources):</th></tr>
<tr><td>dependent variable, function, independent variable, function notation, linear function, decreasing (function), horizontal intercept, increasing (function), maximum (of a function), minimum (of a function), vertical intercept, average rate of change, domain, range (of a function), piecewise function, absolute value, vertex (of a graph), inverse (function),</td><td>Desmos Classroom Released Activities</td></tr>
</table>

<table>
<tr><th>Opportunities for Interdisciplinary Connections:</th><th>Anticipated misconceptions:</th></tr>
<tr><td>Science
• Functions describe real-world scientific phenomena such as population growth, radioactive decay, and projectile motion. Exponential functions model bacteria growth and decay, while quadratic functions describe the trajectory of objects in physics and engineering.
Social Studies
• Exponential functions model financial growth, such as compound interest, and demographic trends, such as population growth or decline.
Health & Physical Education
• Functions model heart rate recovery after exercise, which follows an exponential decay pattern, helping students understand cardiovascular health. Distance-time graphs in sports measure speed and endurance, connecting math to athletic performance and health science.
Personal Finance
• Many activities refer to investments and debt, both of which grow exponentially.</td><td>• Many students interpret the exponent as multiplication
• Students may conflate an increase of n% with a growth factor of n.
• Students often confuse x^2 and 2^x.
• Students often use the decay rather than 1-decay as the growth factor for exponential decay.
• Students often assume that all functions grow at a constant rate, leading them to misinterpret exponential growth as linear growth or vice versa.
• Students may confuse t = 0 and t = 1.
• Students may believe that any growth factor that is a fraction represents exponential decay because they assume all fractions are less than one.
• Students may conflate 1.05 and 1.5 or think that 1.5 is ⅕ or 1 ⅕</td></tr>
<tr><th>Connections to Prior Units:</th><th>Connections to Future Units:</th></tr>
<tr><td>Exponential functions grow by multiplying a fixed factor, while linear functions grow by adding a constant aMiddle of Unitnt. Comparing these models, such as simple vs. compound interest, helps students understand different patterns of change in real-world situations.

Exponential functions can model data that shows curved trends, such as population growth or radioactive decay. Students use scatter plots and regression to determine whether an exponential or linear function best fits a given set of data.</td><td>Connection to Unit 6: Quadratic Functions
• Understanding of non-linear growth patterns extends to quadratic growth
• Work with exponents transfers to squared terms in quadratic expressions
• Experience with curved graphs prepares for parabolas
• Comparing rates of change at different points prepares for varying rates in quadratics
• Understanding y-intercept as initial value continues with quadratic contexts
• Experience with multiple representations (graphs, tables, equations) transfers to quadratics
• Analyzing key features of graphs (intercepts, increasing/decreasing) extends to parabolas
• Interpreting parameters in context continues with quadratic models
• Using technology to explore graphs carries forward</td></tr>
<tr><th colspan="2">Differentiation through Universal Design for Learning</th></tr>
<tr><th>UDL Indicator</th><th>Teacher Actions:</th></tr>
<tr><td colspan="2">Engagement
• Growth and Decay Contexts
    • Uses compelling real-world scenarios (population growth, compound interest)
    • Connects to student interests through financial literacy
    • Provides authentic purposes for modeling growth patterns
• Pattern Investigation
    • Encourages discovery of exponential patterns
    • Allows for hands-on exploration of growth
    • Builds from concrete to abstract understanding
Representation
• Multiple Representations of Growth
    • Presents exponential relationships through tables, graphs, and equations
    • Uses visual models to show repeated multiplication
    • Connects percent change to exponential growth
• Language Development</td></tr>
</table>

- Builds vocabulary for exponential contexts
    - Connects everyday growth language to mathematical terms
    - Provides structured ways to describe rates of change

Action and Expression
- Varied Solution Strategies
- Technology Integration
    - Uses calculators for exponent computation
    - Employs graphing tools for visualization
    - Supports exploration of different growth rates

Specific Unit 5 Applications
- Introduction to Growth (Lessons 1-2)
    - Multiple ways to recognize exponential patterns
    - Various contexts for growth exploration
    - Different approaches to describing change
- Growth and Decay (Lessons 3-7)
    - Visual and numerical representations
    - Multiple contexts for decay
    - Various approaches to negative exponents
- Functions and Modeling (Lessons 8-13)
    - Different ways to represent exponential functions
    - Multiple approaches to rate analysis
    - Various modeling strategies
- Financial Applications (Lessons 14-18)
    - Real-world connections to money growth
    - Multiple representations of interest
    - Various compounding scenarios
- Comparing Growth Types (Lessons 19-21)
    - Different methods for comparing rates
    - Multiple ways to analyze patterns
    - Various prediction strategies

Supporting Multilingual/English Learners

The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners:

MLR1: *Stronger and Clearer Each Time* - Students revise and refine their mathematical language through multiple drafts
MLR2: *Collect and Display* - Students capture and organize language in visual displays
MLR3: *Clarify, Critique, Correct* - Students analyze mathematical writing/talk
* MLR4: *Information Gap* - Students share information to solve problems
* MLR5: *Co-Craft Questions* - Students create and improve questions
MLR6: *Three Reads* - Students analyze complex mathematical text
* MLR7: *Compare and Connect* - Students connect different mathematical representations
MLR8: *Discussion Supports* - Students participate in mathematical discussions

MLR4: Information Gap
Used for exploring exponential growth patterns
Partners share information to complete problems

MLR5: Co-Craft Questions
Students create questions about exponential situations
Helps develop understanding of exponential relationships

MLR7: Compare and Connect
Used to compare linear and exponential growth
Connect different representations of exponential functions

Related [CELP standards:](#)	**Learning Targets:**

An MLL...determine the meaning of words and phrases in oral presentations and literary and informational text.
Learning Target: I can represent, analyze, and interpret functions in multiple forms to describe relationships, recognize patterns, compare characteristics, and model real-world situations, including exponential growth and decay.

- **Level 1:** With prompting and supports, I can use words, numbers, and visuals to show and describe basic function relationships, such as increasing or decreasing.
- **Level 2:** With prompting and supports, I can use simple sentences, tables, and graphs to explain how a

function changes and what it represents in a real-world situation.

- **Level 3:** With guidance and support, I can describe and compare functions using equations, graphs, and tables, and explain patterns in exponential growth and decay.
- **Level 4:** I can analyze and interpret functions in multiple forms, explain how different representations connect, and apply them to real-world problems.
- **Level 5**: I can fluently analyze, compare, and justify functions using precise mathematical language, explaining how different representations highlight key characteristics in real-world situations.

Lesson Sequence	Learning Target	Success Criteria/Assessment
Section A: Looking at Growth Lessons 1-2	• I can compare linear and exponential relationships by performing calculations. • I can describe patterns in tables that represent linear and exponential relationships.	Lesson 1 • I can compare growth patterns using calculations and graphs. Lesson 2 • I can use words and expressions to describe patterns in tables of values. • When I have descriptions of linear and exponential relationships, I can write expressions and create tables of values to represent them. Checkpoint A problem 1 Checkpoint A problem 2
Section B: A New Kind of Relationship Lessons 3-7	• I can interpret a negative exponent in equations that represent exponential growth or decay. • I can write an equation of the form $y = a \cdot b^x$ to represent a quantity a that changes by a growth factor b. • I can write and graph an equation that represents exponential decay to solve problems.	Lesson 3 • I can explain the connections between an equation and a graph that represents exponential growth. • I can write and interpret an equation that represents exponential growth. Middle of Unit problem 1 *NOTE: Middle of Unit Problem 1 Notes say no calculator for the test. None of the high school standards involve computation so calculators should be allowed.* Middle of Unit Problem 4 End of Unit Problem 1 • I can graph equations that represent quantities that change by a growth factor that is greater than 1. Middle of Unit Problem 6 Lesson 4 • I can explain the meanings of a and b in an equation that represents exponential decay and is written as $y = a \cdot b^x$. Checkpoint B Problem 1 • I can find a growth factor from a graph and write an equation to represent exponential decay. • I can graph equations that represent quantities that change by a growth factor that is between 0 and 1. Checkpoint B problem 3 Lesson 5 • I can use only multiplication to represent "decreasing a quantity by a fraction of itself." • I can write an expression or equation to represent a quantity that decays exponentially. Checkpoint B Problem 1 • I can interpret an equation that represents exponential decay. Middle of Unit Problem 7

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I know the meanings of “exponential growth” and “exponential decay.”
Lesson 6
I can use graphs to compare and contrast situations that involve exponential decay.
I can use information from a graph to write an equation that represents exponential decay.
Lesson 7
I can describe the meaning of a negative exponent in equations that represent exponential decay.
Checkpoint B problem 2
Middle of Unit Problem 5 Part 2
I can write and graph an equation that represents exponential decay to solve problems.
Middle of Unit Problem 7
</td>
</tr>
<tr>
<td>Section C: Exponential Functions Lessons 8-13</td>
<td>
I can describe the effect of changing a and b on a graph that represents $y = a \bullet b^x$.
I can use function notation to write equations that represent exponential relationships.
</td>
<td>
Lesson 8
I can use function notation to write equations that represent exponential relationships.
End of Unit Problem 1
When I see relationships in descriptions, tables, equations, or graphs, I can determine whether the relationships are functions.
Checkpoint C Problem 1.1
Lesson 9
I can analyze a situation and determine whether it makes sense to connect the points on the graph that represents the situation.
When I see a graph of an exponential function, I can make sense of and describe the relationship using function notation.
Middle of Unit Problem 5
Lesson 10
I can calculate the average rate of change of a function over a specified period of time.
I know how the average rate of change of an exponential function differs from that of a linear function.
Lesson 11
I can use exponential functions to model situations that involve exponential growth or decay.
Checkpoint C problem 1.2
When given data, I can determine an appropriate model for the situation described by the data.
Middle of Unit Problem 3
Lesson 12
I can describe the effect of changing $a$and b on a graph that represents $f(x) = a \cdot b^x$.
Checkpoint C Problem 2
Middle of Unit Problem 2
I can use equations and graphs to compare exponential functions.
Lesson 13
I can explain the meaning of the intersection of the graphs of two functions in terms of the
</td>
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</table>

		situations they represent. • When I know two points on a graph of an exponential function, I can write an equation for the function. End of Unit Problem 6 *NOTE: End of Unit Problem 6* *Problem 6 is more difficult to interpret than it is to answer. If the idea is that the output is 2^3 times larger after x increases by 3, it should be worded that way.*
Section D: Percent Growth and Decay Lessons 14-18	• I can calculate the result of repeated percent increase for the same initial balance and interest rate, but compounded at different intervals. • I can justify why applying a percent increase p, n times, is not equivalent to applying the percent np.	Lesson 14 • I can find the result of applying a percent increase or decrease on a quantity. • I can write different expressions to represent a starting point and a percent increase or decrease. Checkpoint D Problem 1 End of Unit Problem 3 Lesson 15 • I can use graphs to illustrate and compare different percent increases. • I can write a numerical expression or an algebraic expression to represent the result of applying a percent increase repeatedly. End of Unit Problem 5 Lesson 16 • I can explain why applying a percent increase, p, n times is like or unlike applying the percent increase np. Checkpoint D Problem 1 Lesson 17 • I can calculate interest when I know the starting balance, interest rate, and compounding intervals. End of Unit problem 2 End of Unit problem 4 • When given interest rates and compounding intervals, I can choose the better investment option. Checkpoint D Problem 2 Lesson 18 • I can solve problems using exponential expressions written in different ways. End of Unit Problem 2 • I can write equivalent expressions to represent situations that involve repeated percent increase or decrease. End of Unit Problem 3
Section E: Comparing Linear and Exponential Functions Lessons 19-20	• I can use rates of change, and show that, for any equal intervals of the independent variable, an exponential function always increases or decreases by an equal factor. • I can use tables, calculations, and graphs to compare growth rates of linear and exponential functions.	Lesson 19 • I can use tables, calculations, and graphs to compare growth rates of linear and exponential functions and to predict how the quantities change eventually. Checkpoint E Problem 2 End of Unit Problem 7 Lesson 20 • I can calculate rates of change of functions given graphs, equations, or tables.

		• I can use rates of change to describe how a linear function and an exponential function change over equal intervals. Checkpoint E problem 1 End of Unit problem 6
Section F: Let's Put It to Work Lesson 21	• I will choose and write a linear or exponential function to model real-world data. • I can determine and explain (in writing) how well a function models the given data. • I can use given population data to calculate or estimate growth rates and make predictions.	Lesson 21 • I can determine how well a chosen model fits the given information. • I can determine whether to use a linear function or an exponential function to model real-world data.

Unit Title:
Unit 6: Introduction to Quadratic Functions ([iM Unit 7])
Relevant Standards: Bold indicates priority

HSA-SSE.A	HSF-BF.A.1	HSF-IF.A.2	HSF-LE.A.1	HSN-Q.A.1	HSS-ID.B.6.a
HSA-SSE.A.1	HSF-BF.A.1.a	HSF-IF.B	HSF-LE.A.1.a	HSN-Q.A.2	
HSA-SSE.A.1.b	HSF-BF.B.3	HSF-IF.B.4	HSF-LE.A.1.b	HSN-Q.A.3	
HSA-SSE.A.2		HSF-IF.B.5	HSF-LE.A.1.c		
HSA-SSE.B.3		HSF-IF.B.6	HSF-LE.A.2		
HSA-SSE.B.3.c		HSF-IF.C	HSF-LE.A.3		
		HSF-IF.C.7	HSF-LE.B.5		
		HSF-IF.C.7.a			
HSA-APR.A		HSF-IF.C.7.e			
		HSF-IF.C.8			
		HSF-IF.C.9			

Essential Question(s):	**Enduring Understanding(s):**
• How do different forms of a function's equation help us understand its key features and behavior? • What do the key features of a function—such as intercepts, maximums, minimums, and end behavior—reveal about its graph and real-world meaning? • How do transformations, such as shifts, reflections, and stretches, affect the graph and equation of a function? • How do we determine whether a function best models a real-world situation as linear, quadratic, or exponential? • What are the different kinds of growth and how do they compare? • How can we analyze and compare functions that are represented in different ways, such as equations, graphs, tables, and verbal descriptions? • How can expressing the same equation in different forms reveal different properties of a quadratic function?	• Functions can be represented in multiple ways—algebraically, graphically, numerically, and verbally—and each representation provides different insights into the function's behavior. • Rewriting expressions through factoring, expanding, and completing the square reveals important characteristics of functions, such as zeros, intercepts, and vertex points. • Transformations, including shifts, reflections, stretches, and compressions, help us understand how function graphs change and how different functions relate to one another. • The structure of an algebraic expression can be analyzed and rewritten to make solving equations easier and to reveal key features of the function it represents. • Exponential, linear, and quadratic functions model different types of real-world relationships, and understanding their differences allows us to choose the best function for a given situation. • Comparing functions in different forms—such as equations, tables, graphs, and descriptions—helps us analyze relationships and make predictions. • Projectile motion can be represented using a quadratic function.
Demonstration of Learning:	**Pacing for Unit**
Section A Checkpoint Section B Checkpoint Section C Checkpoint Mid-Unit Assessment Section D Checkpoint End-of-Unit Assessment	[iM v.360 Pacing and Vertical Content Alignment (gr. 6-11)]
Family Overview (link below)	**Integration of Technology:**
https://accessim.org/9-12-aga/algebra-1/unit-7?a=family	Desmos Graphing Technology
Unit-specific Vocabulary:	**Aligned Unit Materials, Resources, and Technology (beyond core resources):**
Quadratic expression, quadratic function, vertex, zero, factored form, standard form, vertex form	Desmos Released Classroom Activities

Opportunities for Interdisciplinary Connections:

Science
- Quadratic functions describe projectile motion and acceleration in physics, helping students understand real-world applications of parabolic paths.
- Transformations of functions relate to wave motion, sound frequencies, and light reflection in physics.

Economics & Business
- Linear and quadratic models help analyze profit, revenue, and cost trends in business scenarios.
- Understanding function transformations allows for predicting market growth and stock trends over time.

Computer Science & Engineering
- Quadratic and exponential functions play a role in algorithm efficiency and machine learning models in computer science.
- Graph transformations and function comparisons help analyze digital image processing, scaling, and animation effects in game development.

Anticipated misconceptions:

- Many students misunderstand that transformations (shifts, reflections, stretches) apply to all points on a function, not just specific ones like the vertex.
- Some students assume that exponential and quadratic functions both grow at a constant rate instead of recognizing that exponentials grow by multiplication while quadratics do not.
- Students may incorrectly believe that the x-intercepts (solutions) are always the maximum or minimum of the function, rather than understanding how the vertex relates to symmetry and extrema.
- Some students struggle to compare functions across different representations (graph, table, equation, verbal) and focus only on algebraic form.

Connections to Prior Units:

Prior to this unit, students have studied what it means for a relationship to be a function, used function notation, and investigated linear and exponential functions. In this unit, they look at some patterns that grow quadratically and contrast this growth with linear and exponential growth.

Connections to Future Units:

Connections to Units in Future Courses

Transformations of Functions
- Understanding shifts, reflections, stretches, and compressions of functions lays the foundation for geometric transformations in Geometry and function transformations in Algebra 2, including rational, logarithmic, and trigonometric functions.

Circles, Higher-Degree Polynomials, and Rational Expressions
- Skills like factoring and completing the square extend to deriving the equation of a circle in Geometry and factoring and solving higher-degree polynomials in Algebra 2.

Logarithms and Advanced Growth Models
- Working with exponential growth and decay prepares students for logarithmic functions and solving logarithmic equations in Algebra 2, which are used to model real-world scenarios like sound intensity and pH levels.

Inverse Functions
- The concept of inverse functions expands into logarithmic inverses of exponentials and inverse trigonometric functions in Algebra 2.

Differentiation through *Universal Design for Learning*

UDL Indicator	**Teacher Actions:**

Engagement
- Physical Phenomena Connections
    - Uses motion and projectile contexts to introduce quadratics
    - Connects to real-world applications (sports, physics)
    - Provides concrete experiences with parabolic motion
- Pattern Exploration
    - Builds understanding through geometric patterns
    - Encourages investigation of changing rates of change
    - Allows discovery of quadratic relationships

Representation
- Multiple Forms of Quadratics
- Visual and Dynamic Models
    - Employs technology for dynamic graphing

- Uses geometric models to build understanding
- Provides multiple ways to visualize transformations

Action and Expression

- Varied Approaches to Forms
- Technology Integration
  - Uses graphing tools to explore transformations
  - Supports visualization of different forms
  - Enables efficient comparison of representations

Specific Unit 6 Applications

- Introduction to Change (Lessons 1-2)
  - Multiple ways to recognize quadratic patterns
  - Various contexts for exploring change
  - Different approaches to rates of change
- Building Understanding (Lessons 3-7)
  - Geometric pattern exploration
  - Comparison with other function types
  - Multiple modeling contexts
- Different Forms (Lessons 8-10)
  - Various representations of equivalence
  - Multiple approaches to form conversion
  - Different ways to interpret forms
- Graphing Skills (Lessons 11-17)
  - Multiple methods for graphing each form
  - Various approaches to transformations
  - Different strategies for analyzing features

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MLR1: *Stronger and Clearer Each Time* - Students revise and refine their mathematical language through multiple drafts
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* MLR6: *Three Reads* - Students analyze complex mathematical text
MLR7: *Compare and Connect* - Students connect different mathematical representations
*MLR8: *Discussion Supports* - Students participate in mathematical discussions

MLR2: Collect and Display
Organizing quadratic patterns and relationships
Creating visual representations of quadratic functions
MLR6: Three Reads
Applied to projectile motion problems
Breaking down complex quadratic contexts
MLR8: Discussion Supports
Structured discussions about quadratic features
Supporting vocabulary for quadratic relationships

Related CELP standards:	**Learning Targets:**

An EL can . . . construct grade appropriate oral and written claims and support them with reasoning and evidence.
Learning Target: I can understand and represent quadratic functions using different forms (standard, factored, vertex), and I can identify key features of their graphs.

- **Level 1**: With prompting and supports, I can recognize basic characteristics of quadratic functions and graphs.
- **Level 2**: With prompting and supports, I can identify key parts of a quadratic graph, like the vertex and its intercepts.
- **Level 3**: With guidance and supports, I can represent quadratic functions in standard or factored form and find key features like the vertex and its intercepts.
- **Level 4**: I can use different forms of quadratic functions (standard, factored, vertex) to graph and analyze key features.
- **Level 5**: I can analyze and solve quadratic functions using multiple representations and describe the

relationships between the features of the graph and the equation.		
Lesson Sequence	**Learning Target**	**Success Criteria/Assessment**
Section A: A Different Kind of Change Lessons 1-2	• I can comprehend that a "quadratic relationship" can be expressed with a squared term. • I can determine and explain whether a visual pattern represents a linear, exponential, or quadratic relationship.	Lesson 1 • I can create drawings, tables, and graphs that represent the area of a garden. • I can recognize a situation represented by a graph that increases and then decreases. Lesson 2 • I can describe how a pattern is growing. Checkpoint B Problem 1 Middle of Unit Problem 1 • I can tell whether a pattern is growing linearly, exponentially, or quadratically. Checkpoint A Middle of Unit Problem 1 • I know a quadratic expression has a squared term. Checkpoint A
Section B: Quadratic Functions Lessons 3-7	• I can interpret quadratic functions that represent a physical phenomenon, given expressions and graphs. • I can use graphs, tables, and calculations to show that exponential functions eventually overtake quadratic functions.	Lesson 3 • I can explain using graphs, tables, or calculations that exponential functions eventually grow faster than quadratic functions. Middle of Unit Problem 5 • I can recognize quadratic functions written in different ways. • I can use information from a pattern of shapes to write a quadratic function. Middle of Unit Problem 1 Lesson 4 • I can explain using graphs, tables, or calculations that exponential functions eventually grow faster than quadratic functions. Middle of Unit Problem 5 Lesson 5 • I can explain the meaning of the terms in a quadratic expression that represents the height of a falling object. Checkpoint B Problem 2 Middle of Unit Problem 2 • I can use tables, graphs, and equations to represent the height of a falling object. Lesson 6 • I can create quadratic functions and graphs that represent a situation. • I can relate the vertex of a graph and the zeros of a function to a situation. • I know that the domain of a function can depend on the situation it represents. Middle of Unit Problem 2 Lesson 7 • I can choose a domain that makes sense in a revenue situation. Middle of Unit Problem 7 • I can model revenue with quadratic functions and graphs. Middle of Unit Problem 4

		NOTE: *Middle of Unit Problem 4 Test question context is area but the Lesson is based on revenue, may want to preview revenue.* Middle of Unit Problem 7 • I can relate the vertex of a graph and the zeros of a function to a revenue situation.
Section C: Working with Quadratic Expressions Lessons 8-10	• I can coordinate a quadratic expression given in factored form and the intercepts of its graph. • I can use the distributive property to write equivalent quadratic expressions from factored into standard form.	Lesson 8 • I can rewrite quadratic expressions in different forms by using an area diagram or the distributive property. Checkpoint C Middle of Unit Problem 3 Middle of Unit Problem 6 Lesson 9 • I can rewrite quadratic expressions given in factored form, in standard form, using either the distributive property or a diagram. Middle of Unit Problem 3 Middle of Unit Problem 6 • I know the difference between “factored form” and “standard form.” Checkpoint C Lesson 10 • I can explain the meaning of the intercepts on a graph of a quadratic function in terms of the situation it represents. Middle of Unit Problem 7 End of Unit Problem 5 *NOTE: End of Unit Problem 5 Clare’s function in factored form should be looked at. Question b. Give a different time value so that someone’s height is higher and they are NOT the same. Difficult to understand why a student made an error.* End of Unit Problem 7 • I know how the numbers in the factored form of a quadratic expression relate to the intercepts of its graph. Middle of Unit Problem 7 End of Unit Problem 5 End of Unit Problem 7
Section D: Features of Graphs of Quadratic Functions Lessons 11-17	• I can explain how a graph is affected by changing parameters in quadratic expressions written in standard, factored, and vertex forms. • I can use an equation in vertex form to identify the maximum or minimum of a quadratic function.	Lesson 11 • I can graph a quadratic function given in factored form. End of Unit Problem 4 • I know how to find the vertex and y-intercept of the graph of a quadratic function in factored form without graphing it first. End of Unit Problem 4 End of Unit Problem 5 Lesson 12 • I can explain how the a and c in $y = ax^2 + bx + c$ affect the graph of the equation. Checkpoint D Problem 1 End of Unit Problem 3

		- I understand how graphs, tables, and equations that represent the same quadratic function are related. Lesson 13 - I can explain how the b in $y = ax^2 + bx + c$ affects the graph of the equation. - I can match equations given in standard and factored form with their graph. End of Unit Problem 1 End of Unit Problem 2 Lesson 14 - I can explain how a quadratic equation and its graph relate to a situation. End of Unit Problem 5 Lesson 15 - I can recognize the "vertex form" of a quadratic equation. - I can relate the numbers in the vertex form of a quadratic equation to its graph. End of Unit Problem 2 End of Unit Problem 6 Lesson 16 - I can graph a quadratic function given in vertex form, showing a maximum or minimum and the y-intercept. - I know how to find a maximum or a minimum of a quadratic function given in vertex form without first graphing it. Checkpoint D Problem 2 End of Unit Problem 6 Lesson 17 - I can describe how changing a number in the vertex form of a quadratic function affects its graph. End of Unit Problem 6