

Course Title	Content Area	Grade Level	Credit (if applicable)
Grade 8 Math: Algebra +	Mathematics	Grade 8	N/A <i>(If course is passed (65% or higher), eligible for 1.0 HS Math Credit after completing 3 credits of HS Math)</i>

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 **Connection to the *BPS Vision of the Graduate***

[CT Core Standards](#) (aligned to [National Common Core Standards](#))

[Imagine Learning iM Resources](#) (Alg 1, Geom, Alg 2)
BPS teacher login through [ClassLink](#) required

<https://accessim.org/9-12-aga/algebra-1/course-guide/further-reading?a=teacher>

- [Empowering All Storytellers: Tips for Engaging Special Populations Using IM® v.360 for Grade 6-12](#)
- [Tackling Wordy Problems: How the Three Reads Math Language Routine Supports Access for All Learners](#)
- [Think Pair Share](#)
- [Math Language Routines: Discourse with a Purpose](#)
- [Unlocking Learners' Thinking Using the Mathematical Language Routines](#)

Common Core State Standards: Math Practice (MP) Standards

- MP 1: Make sense of problems and persevere in solving them.
- MP 2: Reason abstractly and quantitatively.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 5: Use appropriate tools strategically.
- MP 6: Attend to precision.
- MP 7: Look for and make use of structure.
- MP 8: Look for and express regularity in repeated reasoning.

	Lessons that Showcase Math Practice Standards							
	Unit 1 Alg 1 U3	Unit 2 Alg 1 U2	Unit 3 Alg 1 U4	Unit 4 Alg 1 U5	Unit 5 G8 U7	Unit 6 Alg 1 U6	Unit 7 G8 Review	Unit 8 Alg 1 U7
MP 1	1, 10	3, 5, 18	2, 7-9	1, 6, 12, 16, 18	2, 4, 6, 11	3, 9, 21		4, 14, 17
MP 2	3-9	2-4, 6, 10-12, 15, 17	1-3, 6, 7, 9	2-11, 15, 16	15	2, 4, 5, 7-11, 13, 14, 19		1, 3, 6, 7, 12, 14
MP 3	6-7	3, 7, 11, 14-16	-	8, 12	1, 2, 4, 5, 8, 11, 12, 15	1, 3, 10, 12, 17, 19		2, 3, 12, 15-17
MP 4	3, 4, 8-10	1, 4, 9, 10, 12, 19	1, 5, 9	1, 7, 8, 11, 17, 18	16	4, 6-9, 11, 16, 17, 21		7, 17
MP 5	2, 3, 10	1, 9, 11, 12, 15, 17	7, 9	5, 10, 13, 15, 18	3	1, 3, 4, 7, 8, 11, 12, 18, 21		1, 4, 6, 12
MP 6	1, 2, 4, 7	5, 7, 12, 17, 18	8	2, 3, 6-9, 11, 16	3, 4, 9, 10	1, 2, 5, 6, 8, 9, 13, 18, 21		7, 9, 11, 14, 15
MP 7	1, 3, 5-8	2, 3, 7, 11, 13, 17-19	3, 4	4, 9-11, 14	1, 4, 5, 7, 9, 13, 14	2-4, 6, 14, 18, 20		1-5, 8-13, 15-17
MP 8	2	2, 3, 8, 11, 19	4, 5	13-15	2, 3	5, 7, 15, 19, 20		2, 5-7, 9-13, 15

Bristol Public Schools Vision of the Graduate

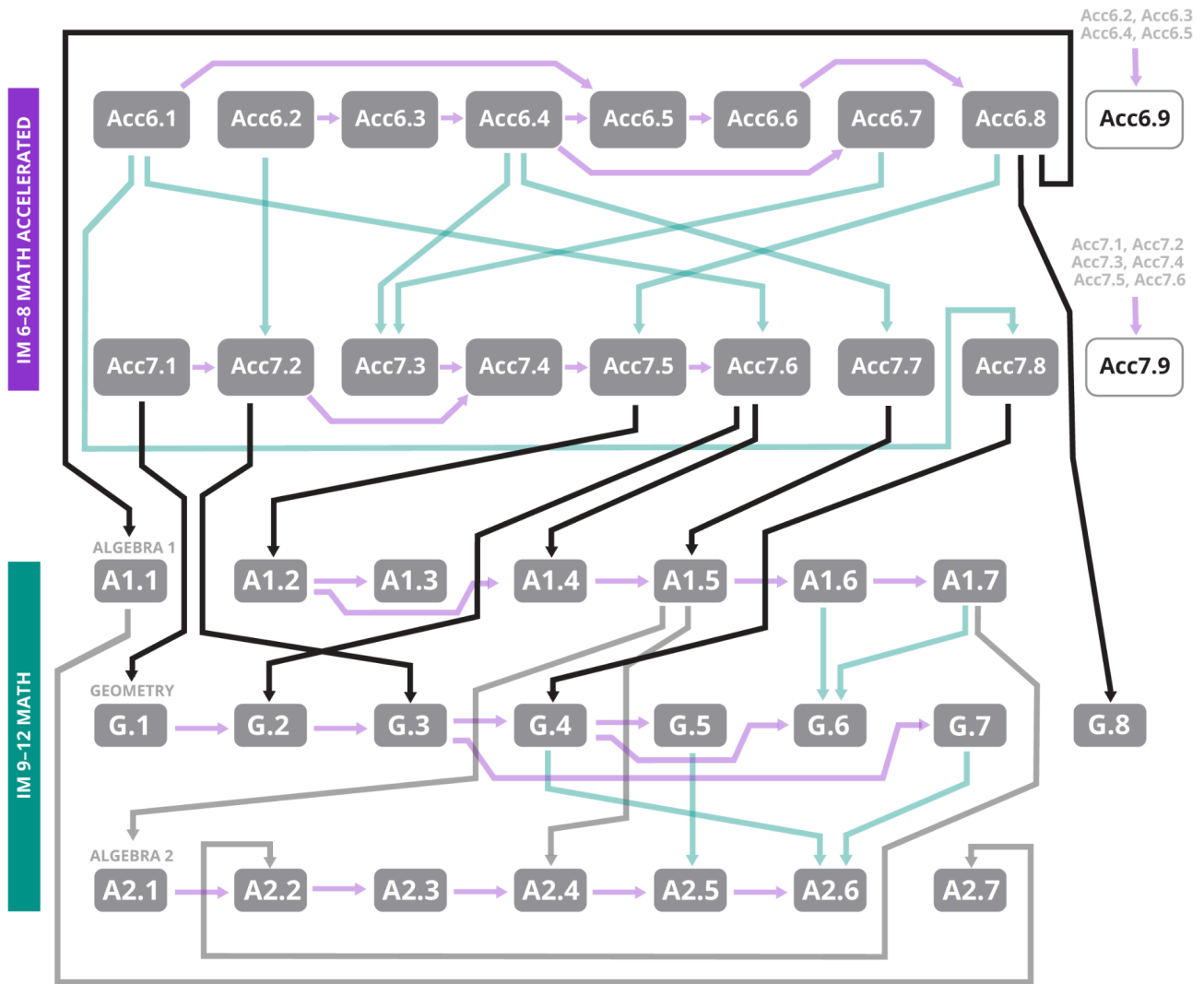
- Problem Solving**
- iM's focus on real-world modeling and problem-solving strategies
 - Multiple solution pathways are encouraged and explored
 - Students develop perseverance through challenging tasks
- Critical Thinking**
- Students analyze mathematical relationships and justify their reasoning

- 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

Link to [Equity Audit](#)

[Equity Curriculum Review Audit \(Gr. 8 Alg+\)](#)

Additional Course Information:
Knowledge/Skill Dependent courses/prerequisites



Standard Matrix

Standard	Unit 1 Alg 1 U3	Unit 2 Alg 1 U2	Unit 3 Alg 1 U4	Unit 4 Alg 1 U5	Unit 5 G8 U7	Unit 6 Alg 1 U6	Unit 7 G8 Review	Unit 8 Alg 1 U7
8.EE.A.1					2-8, 11, 14			
8.EE.A.3					9-12, 14, 16			
8.EE.A.4					10-16			
HSA-APR.A								8, 9
HSA-CED.A.1			3	13				
HSA-CED.A.2		1-3, 5, 6				3-7		
HSA-CED.A.3		1-3, 5, 9, 10, 12, 17	1, 3, 5-7, 9					

HSA-CED.A.4		8-11		16			
HSA-REI.A		4, 7, 12					
HSA-REI.A.1		6, 7		5			
HSA-REI.B.3		4, 8, 9	2, 3				
HSA-REI.C		18, 19					
HSA-REI.C.5		16					
HSA-REI.C.6		12-18					
HSA-REI.D.10		5, 10, 11	5				
HSA-REI.D.11				9			
HSA-REI.D.12			4-9				
HSA-SSE.A					9, 17		8, 11
HSA-SSE.A.1		6			5, 7, 17		2, 3
HSA-SSE.A.1.b					18		
HSA-SSE.A.2							8, 9
HSA-SSE.B.3							2, 8, 9, 10, 13
HSA-SSE.B.3.c					18		
HSF-BF.A.1				14, 17, 18	11, 15		6
HSF-BF.A.1.a				4, 14	2, 3, 5, 15-17		1-7
HSF-BF.A.1.b		2, 14-16 U2 L14					
HSF-BF.B.3				14			12, 13, 15, 17
HSF-BF.B.4				15-17			
HSF-BF.B.4.a				17			
HSF-IF.A.1				1, 2, 4			
HSF-IF.A.2				2-5, 12, 17	18, 9, 11, 17, 18, 19		3, 5, 14
HSF-IF.A.3							2
HSF-IF.B				10	8		
HSF-IF.B.4				1-6, 8, 9, 11, 17	1, 2, 4, 6, 11-13 , 19		14
HSF-IF.B.5				10-12		8, 9, 11, 19	6, 7
HSF-IF.B.6				7-9, 18	10, 15		
HSF-IF.C				4, 12-14			4, 6, 12, 15-17
HSF-IF.C.7				12	8		12, 13
HSF-IF.C.7.a		10					6, 7, 11, 13-17
HSF-IF.C.7.b				12-14			
HSF-IF.C.7.e					9, 15		
HSF-IF.C.8					18		14
HSF-IF.C.9					2, 6, 12		14
HSF-LE.A.1					11, 19, 21		

HSF-LE.A.1.a						20		
HSF-LE.A.1.b						20,21		
HSF-LE.A.1.c						11,21		
HSF-LE.A.2						8,9,11,13,15, 19-21		12
HSF-LE.A.3						1,19		4
HSF-LE.B.5						3-5, 11-13		
HSN-Q.A.1						7,8,11		
HSN-Q.A.2		1	9			17		
HSN-Q.A.3		6				11, 21		
HSS-ID.B.5	1-3							
HSS-ID.B.6	4, 7-10							
HSS-ID.B.6.a	4, 6, 8			17,18		11,21		
HSS-ID.B.6.b	6							
HSS-ID.B.6.c	5,6		17,18					
HSS-ID.C.7	4,5,8,10							
HSS-ID.C.8	7,8,10							
HSS-ID.C.9	9,10							

Unit Links

[Grade 8 Algebra +](#)
[Unit 1: Two Variable Statistics \(iM U3\)](#)
[Unit 2: Linear Equations and Systems \(iM U2\)](#)
[Unit 3: Linear Inequalities and Systems \(iM U4\)](#)
[Unit 4: Functions \(iM U5\)](#)
[Unit 5: Exponents and Scientific Notation \(G8 U7\)](#)
[Unit 6: Introduction to Exponential Functions \(iM U6\)](#)
[Unit 7: Topics in Grade 8 \(BPS\)](#)
[Unit 8: Introduction to Quadratic Functions \(iM U7\)](#)
[Course Assessment Map](#)

Use of Instructional Time (181 School Days)

- 156 iM Content and Assessment Days
- 6 Climate and Culture Days: 2 days at start of year, 2 shortened days before breaks, and 2 days at end of year
- Midterm Exam: 2 Review Days, 1 Administering
- 9 IAB Days: 1 day Strategic Review and 2 day IAB in fall, winter, and spring
- 4 SBA Days: 1 day Strategic Review and 3 day SBA
- Final Exam: 2 Review Days, 1 Administering

Unit Title:			
Unit 1: Two Variable Statistics (iM U3)			
Relevant Standards: Bold indicates priority			
Lesson	Standards	Lesson	Standards
Lesson 1	HSS-ID.B.5	Lesson 6	HSN-Q-A.3, HSS-ID.B.6.a, HSS-ID.B.6.b, HSS-ID.B.6.c
Lesson 2	HSS-ID.B.5	Lesson 7	HSS-ID.B.6, HSS-IDC.8
Lesson 3	HSS-ID.B.5	Lesson 8	HSS-ID.B.6, HSS-ID.B.6.a, HSS-IDC.7, HSS-IDC.8
Lesson 4	HSS-ID.B.6, HSS-ID.B.6.a, HSS-IDC.7	Lesson 9	HSS-ID.B.6, HSS-IDC.9
Lesson 5	HSS-ID.B.6.a, HSS-IDC.7	Lesson 10	HSS-ID.B.6, HSS-IDC.7, HSS-IDC.8, HSS-IDC
Essential Question(s):		Enduring Understanding(s):	
<ul style="list-style-type: none"> 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 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? 		<ul style="list-style-type: none"> 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. 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	
CFA 1: Checkpoint A (after lesson 3) CFA 2: Checkpoint B (after lesson 5) NOTE: Consider adding a question involving finding the line of best fit using technology and making a prediction using the equation. CFA 3: Checkpoint C (after lesson 8) End of Unit Assessment A (after lesson 9) 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.		14 Days Lesson Modifications: <ul style="list-style-type: none"> Remove Activity 1.3: This activity can be moved to practice outside of class. Remove Activity 3.3: This activity invites students to invent their own data for imagined variables. It is an additional opportunity for students to explore association, but does not introduce new concepts. Remove Lesson 6: This lesson explores residuals. No subsequent lessons address this topic, so if time is an issue, it can be removed. Remove Lesson 10: This lesson is optional. Lessons that might need to be reviewed: <ul style="list-style-type: none"> 8.6.9: Activities 2 and 3 8.6.3: Scatter plots 8.6.4: Fit lines 	
Family Overview		Integration of Technology:	
https://accessim.org/9-12-aga/algebra-1/unit-3?a=family		<ul style="list-style-type: none"> Desmos Online Graphing Calculator Pear Assessment (Edulastic) iM v.360 Digital Applets (see below) 	
Unit-specific Vocabulary:		Aligned Unit Materials, Resources, and Technology	
categorical variable, two-way table, variable (statistics), relative frequency table, association, residual, correlation coefficient, negative relationship, positive relationship, strong relationship, weak relationship, causal relationship		Digital Applets <ul style="list-style-type: none"> Alg1.3.4 Digital Activity 1: Orange You Glad We're Boxing Fruit? Alg1.3.5 Digital Activity 2: Fitting Lines with Technology Alg1.3.6 Digital Activity 1: Oranges Return Alg1.3.8 Digital Activity 1: Never Know How Far You'll Go For whole course:	

<https://accessim.org/9-12-aga/algebra-1/course-guide/required-materials?a=teacher>

Provide access as needed throughout the unit:

- Graphing technology (Examples of graphing technology are a handheld graphing calculator, a computer with a graphing calculator application installed, and an internet-enabled device with access to a site like desmos.com/calculator.)
- Math Community Chart
- Rulers
- Tools for creating a visual display (Any way for students to create work that can be easily displayed to the class. Examples: Chart paper and markers, whiteboard space and markers, shared online drawing tool, access to a document camera.)

Lesson	Materials to Gather	Materials to Copy
1		Running to the Dentist Cards (1 copy for every 2 students): Activity 2
3	Tools for creating a visual display: Activity 2	
5	Graphing technology: Activity 2	Data Patterns Cards (1 copy for every 2 students): Activity 1
6	Graphing technology: Activity 1	Best Residuals Cards (1 copy for every 2 students): Activity 2
7	Math Community Chart: Activity 1	Scatter Plot Fit Cards (1 copy for every 2 students): Activity 1
8	Graphing technology: Activity 1	
10	<ul style="list-style-type: none"> • Rulers: Warm-up • Tools for creating a visual display: Activity 1 	

Opportunities for Interdisciplinary Connections:

- Social Studies & Civic Engagement
- Use two-way tables and relative frequency tables to 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.

Anticipated misconceptions:

- Many students think all variables are numerical or naturally ordered, not recognizing that categorical (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.

See teacher's guide for specific misconceptions aligned to each

	lesson.
Connections to Prior Units:	Connections to Future Units:
Essential prior concepts to engage with this unit: <ul style="list-style-type: none"> • Create a scatter plot, and draw lines to fit data in a scatter plot. • Create and interpret a two-way table. Relevant Unit(s)/Lesson(s) to Review: <ul style="list-style-type: none"> • Grade 8 Unit 6: Associations in Data 	Unit 2: Linear Equations and Systems (iM unit 2) <ul style="list-style-type: none"> • Graphing lines • Interpreting the slope and y-intercept Unit 3: Linear Inequalities and Systems (iM Unit 4) <ul style="list-style-type: none"> • 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 Unit 4: Functions (iM Unit 5) <ul style="list-style-type: none"> • 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
Differentiation through <i>Universal Design for Learning</i>	
Engagement: <ul style="list-style-type: none"> • Brainstorm variable pairs to build off peer ideas (Lesson 9, Activity 2 Launch) Representation: <ul style="list-style-type: none"> • Use color coding and annotations to highlight connections between data tables and graphs (Lesson 6, Activity 1 Launch) Action & Expression: <ul style="list-style-type: none"> • Chunk tasks into manageable parts to support organizational skills (Lesson 1, Activity 1 Launch) 	
Supporting Multilingual Learners	
Math Language Routines The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners: <ul style="list-style-type: none"> MLR1: <i>Stronger and Clearer Each Time</i> - Students revise and refine their mathematical language through multiple drafts MLR2: <i>Collect and Display</i> - Students capture and organize language in visual displays MLR3: <i>Clarify, Critique, Correct</i> - Students analyze mathematical writing/talk MLR4: <i>Information Gap</i> - Students share information to solve problems MLR5: <i>Co-Craft Questions</i> - Students create and improve questions MLR6: <i>Three Reads</i> - Students analyze complex mathematical text MLR7: <i>Compare and Connect</i> - Students connect different mathematical representations MLR8: <i>Discussion Supports</i> - Students participate in mathematical discussions In this unit: <ul style="list-style-type: none"> • MLR1: Stronger and Clearer Each Time (Lesson 9) • MLR2: Collect and Display (Lesson 6) • MLR5: Co-Craft Questions (Lesson 10) • MLR7: Compare and Connect (Lesson 5) • MLR8: Discussion Supports (Lessons 2, 4, 5, 6, 7, 8) 	
Sentence Frames and Stems	
Section A <ul style="list-style-type: none"> • The number of _____ that _____ is _____ because ... • There is _____ association between _____ and _____ because ... • The two-way table represents ... • Using the relative frequency table, I can conclude that ... because ... Section B <ul style="list-style-type: none"> • The scatter plot appears to show a _____ association between _____ and _____ because ... • A linear model is/is not appropriate for this scatter plot because ... • For every _____, the number of _____ increases/decreases by _____. This means ... because ... • The vertical intercept of the scatter plot is about _____. This means ... • The slope of the linear model is _____ and represents ... • The residuals of the data set are ... which mean they have _____ variability and can/cannot be represented with a line of best fit. 	

Section C

- The correlation coefficient $r = \dots$ means the data are \dots and the scatter plot will appear ...
- The data in the scatter plot have a \dots relationship and can/cannot be represented with a line of best fit.
- The relationship between \dots and \dots is/is not causal because ...

Section D

- The relationship between \dots and \dots is \dots because ...
- The correlation coefficient $r = \dots$ means the data are \dots and the scatter plot will appear ...
- The relationship between \dots and \dots is/is not causal because ...

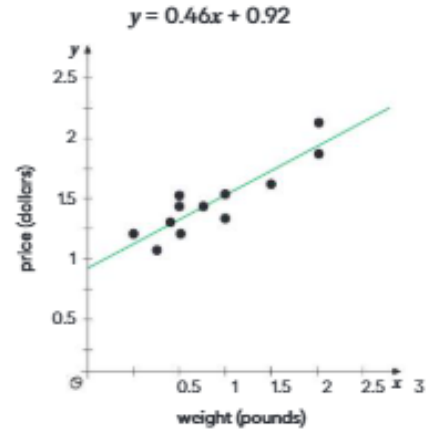
Unit Outline

In this unit, students use statistical methods to look for associations in bivariate data. The unit begins with students analyzing categorical data arranged in two-way tables. Students use the relative frequencies of the combinations of those categorical variables to check for evidence of any associations in the data.

The unit then transitions to bivariate numerical data, which are visualized using scatter plots and lines of best fit. Students use technology to compute the lines of best fit and observe how well the linear models match the data. Residuals and correlation coefficients are used to quantify the goodness of fit for linear models.

The unit closes with an exploration of the difference between correlation and causal relationships, and it is also an opportunity to apply this learning to areas of interest, like anthropology and sports.

In grade 8, students informally constructed scatter plots and lines of fit, noticed linear patterns, and observed associations in categorical data using two-way tables. In this unit, students build on this previous knowledge by assessing how well a linear model matches the data by using residuals as well as the correlation coefficient for best-fit lines (found using technology).



There are opportunities to practice concepts from a previous unit by interpreting the slope and intercept of a linear model in context as well as using the models to predict one variable given information about the other.

Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
<p>Section A: Two-Way Tables Lessons 1-3</p>	<p>Learning Target #1 I can create relative frequency tables from information given in a two-way table or about a situation</p> <p>Learning Target #2 I can inspect patterns in relative frequency tables and two-way tables to determine if there is a possible association between two variables of interest.</p>	<p>Lesson 1 Two-Way Tables</p> <ul style="list-style-type: none"> • 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. <p>Checkpoint A Problem 1 End of Unit Problem 5</p> <p>Lesson 2 Relative Frequency Tables</p> <ul style="list-style-type: none"> • I can calculate values in a relative frequency table and describe what the values mean in everyday language. <p>Lesson 3 Associations in Categorical Data</p> <ul style="list-style-type: none"> • I can look for patterns in two-way tables and relative frequency tables to see if there is a possible association between two variables. <p>End of Unit Problem 6</p>
<p>Checkpoint A</p>	<p>Responding to Student Thinking Press Pause: If students struggle to interpret a two-way table or describe why there is no association between the variables, make time to revisit the idea of relative frequency. For example, use the practice problems referred to here to provide additional practice, and discuss them after students attempt them. Algebra 1, Unit 3, Lesson 4, Practice Problem 5 Algebra 1, Unit 3, Lesson 4, Practice Problem 6</p>	
<p>Section B ScatterPlots (Lessons 4-6)</p>	<p>Learning Target #3 I can comprehend the connection between residuals, variability, and whether or not using a linear model is appropriate.</p>	<p>Lesson 4 Linear Models</p> <ul style="list-style-type: none"> • I can describe the rate of change and y-intercept for a linear model that represents a situation. • I can draw a linear model that fits the data well and use the linear model to estimate values I want to find. <p>Checkpoint B Problem 1</p>

	<p>Learning Target #4 I can interpret the rate of change and vertical intercept for a linear model in the context of a situation.</p>	<p>Lesson 5 Fitting Lines</p> <ul style="list-style-type: none"> 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. <p>Lesson 6 SKIP</p> <ul style="list-style-type: none"> I can plot and calculate residuals for a data set and use the information to judge whether a linear model is a good fit.
<p>Checkpoint B</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Points to Emphasize: If students struggle to interpret the slope and intercept of the linear model in a situation, spend more time practicing the interpretation as opportunities arise over the next few lessons. For example, in the Launch and Activity Synthesis of the activity referred to here, ask students about the meaning of the slope and intercept for the linear model. Algebra 1, Unit 3, Lesson 8, Activity 2 Never Know How Far You'll Go 	
<p>Section C: Correlation Coefficients Lessons 7-9</p>	<p>Learning Target #5 I can describe the strength and sign of the relationship between variables based on the correlation coefficient.</p> <p>Learning Target #6 I can investigate the relationship between two variables to analyze whether or not the relationship is causal.</p>	<p>Lesson 7 The Correlation Coefficient</p> <ul style="list-style-type: none"> I can describe the quality 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 <p>Lesson 8 Using the COrrrelation Coefficient</p> <ul style="list-style-type: none"> 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. <p>Lesson 9 Causal Relationships</p> <ul style="list-style-type: none"> I can look for connections between two variables to analyze whether or not there is a causal relationship End of Unit Problem 4
<p>Checkpoint C</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Press Pause If students struggle to describe whether a relationship is causal or not, make time to revisit the idea. For example, begin the next lesson with the practice problem referred to here. Also consider asking students to look for headlines in news stories claiming a causal relationship between variables. Algebra 1, Unit 3, Lesson 9, Problem 3 	
<p>End of Unit Assessment</p>		

Unit Title:

Unit 2: Linear Equations and Systems (iM U2)

Relevant Standards: Bold indicates priority

Lesson	Standards	Lesson	Standards
Lesson 1	HSA-CED.A.2HSA-CED.A.3HSN-Q.A.2	Lesson 11	HSA-CED.A.4HSA-REI.D.10
Lesson 2	HSA-CED.A.2HSA-CED.A.3HSF-BF.A.1.b	Lesson 12	HSA-CED.A.3HSA-REI.AHSA-REI.C.6
Lesson 3	HSA-CED.A.2HSA-CED.A.3	Lesson 13	HSA-REI.C.6
Lesson 4	HSA-REI.AHSA-REI.B.3	Lesson 14	HSA-REI.C.6HSF-BF.A.1.b
Lesson 5	HSA-CED.A.2HSA-CED.A.3HSA-REI.D.10	Lesson 15	HSA-REI.C.6HSF-BF.A.1.b
Lesson 6	HSA-CED.A.2HSA-REI.A.1HSA-SSE.A.1	Lesson 16	HSA-REI.C.5HSA-REI.C.6HSF-BF.A.1.b
Lesson 7	HSA-REI.AHSA-REI.A.1	Lesson 17	HSA-CED.A.3HSA-REI.C.6
Lesson 8	HSA-CED.A.4HSA-REI.B.3	Lesson 18	HSA-CED.A.4HSA-REI.CHSA-REI.C.6
Lesson 9	HSA-CED.A.3HSA-CED.A.4HSA-REI.B.3	Lesson 19	HSA-CED.A.2HSA-REI.C
Lesson 10	HSA-CED.A.3HSA-CED.A.4HSA-REI.D.10HSF-IF.C.7.a		

Essential Question(s):

- 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?

Enduring Understanding(s):

- 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.

Demonstration of Learning:

CFA 1: Checkpoint A (after Lesson 5)
 CFA 2: Checkpoint B (after Lesson 11)
 CFA 3: Checkpoint C (after Lesson 17)
 End of Unit Assessment (after Lesson 17)

Pacing for Unit

21 Days
 Lessons to Add or Review:

- Combine 8.4.3 and 8.4.4, particularly Activity 3 in Lesson 3 and Activities 2 and 3 in Lesson 4. Focus on the idea of using the same operation with the expressions on each side of an equation or changing the form of one of the expressions through combining like terms, applying the distributive property, and similar operations
- Combine 8.3.8 and 8.3.9. Introduce $y=mx+b$, and include an activity from Lesson 9 to introduce negative slope.
- 8.3.10: Calculating slope
- 8.3.12: Equations for horizontal and vertical lines
- 8.4.12: Solving systems by graphing

Lesson Modifications:

- Combine Lessons 1 and 2: Use an activity from Lesson 1 to introduce the idea of constraint. Remove Activity 1 from Lesson 2.
- Combine Lessons 8 and 9. (Remove 8.2 and the cool down for Lesson 8, and 9.2).
- Combine Lessons 15 and 16.

Family Overview

<https://accessim.org/9-12-aga/algebra-1/unit-2?a=family>

Integration of Technology:

- Desmos Online Graphing Calculator
- Pear Assessment (Edulastic)
- iM v.360 Digital Applets (see below)

Unit-specific Vocabulary:

Aligned Unit Materials, Resources, and Technology

constraint, model, equivalent equations, solution to a system of equations, system of equations, substitution, elimination, equivalent systems

Digital Applets

- Alg1.2.5 Digital Activity 2: Graph It!
- Alg1.2.9 Digital Activity 1: Cargo Shipping

Provide access as needed throughout the unit:

- Four-function calculators
- Graphing technology
- Graph paper
- Math Community Chart
- Spreadsheet technology

Lesson	Materials to Gather	Materials to Copy
1	Math Community Chart: Warm-up	
3	Math Community Chart: Warm-up	
5	Graphing technology: Activity 2	
6	Four-function calculators: Activity 2	
8	Four-function calculators: Activity 1	
9	<ul style="list-style-type: none"> • Four-function calculators: Activity 1 • Spreadsheet technology: Activity 1 	
12	Graphing technology: Activity 1, Activity 2	
14	Graphing technology: Activity 2	
15	Graphing technology: Activity 1, Activity 2	
16	Graphing technology: Warm-up, Activity 1	What Comes Next Cards (1 copy for every 2 students): Activity 2
17	Graphing technology: Warm-up, Activity 1	Sorting System Cards (1 copy for every 2 students): Activity 2
18		Linear Systems Cards (1 copy for every 2 students): Activity 2
19	<ul style="list-style-type: none"> • Graph paper: Activity 1 • Graphing technology: Activity 1 	

Opportunities for Interdisciplinary Connections:

- 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 intake and energy burned.
- Business & Financial Literacy
- Loan & Interest Calculations: Using exponential equations to model credit card interest and loan payments.

Anticipated misconceptions:

- 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 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.

See teacher's guide for specific misconceptions aligned to each lesson.

<p>Computer Science</p> <ul style="list-style-type: none"> Coding Basics: Using algebraic expressions in simple coding projects (e.g., game design or automation). 	
<p>Connections to Prior Units:</p>	<p>Connections to Future Units:</p>
<p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> Solving equations by rewriting them using operations that do not change the equivalence, combining like terms, and applying the distributive property. Graphing equations in slope-intercept form and interpreting the slope and vertical intercept in context. Solving systems of equations by graphing. <p>Relevant Units to Review</p> <p>Grade 7 Bridge</p> <ul style="list-style-type: none"> Unit 4: Equations and Inequalities (G7 ACC U3) Unit 5: Expressions and More Equations (G7 ACC U4) Unit 8: Linear Relationships (G7 ACC U5) 	<p>Connection to Unit 2: Two-Variable Statistics</p> <ul style="list-style-type: none"> 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 <p>Connection to Unit 3: Linear Inequalities and Systems</p> <ul style="list-style-type: none"> 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 <p>Connection to Unit 4: Functions</p> <ul style="list-style-type: none"> 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 <p>Connection to Unit 5: Exponential Functions</p> <ul style="list-style-type: none"> 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 <p>Connection to Unit 8: Quadratic Functions</p> <ul style="list-style-type: none"> 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
<p>Differentiation through <i>Universal Design for Learning</i></p>	
<p>Engagement:</p> <ul style="list-style-type: none"> Leverage choice around perceived challenge in tank problems (Lesson 8, Activity 2 Launch) <p>Representation:</p> <ul style="list-style-type: none"> Create visible connections between mathematical symbols and their real-world meanings (Lesson 1, Activity 2 Launch) <p>Action & Expression:</p> <ul style="list-style-type: none"> Support working memory with sticky notes or mini whiteboards (Lesson 7, Warm-up Launch) 	
<p>Supporting Multilingual Learners</p>	
<p>Math Language Routines</p> <p>The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners:</p> <p>MLR1: <i>Stronger and Clearer Each Time</i> - Students revise and refine their mathematical language through multiple drafts</p> <p>MLR2: <i>Collect and Display</i> - Students capture and organize language in visual displays</p> <p>MLR3: <i>Clarify, Critique, Correct</i> - Students analyze mathematical writing/talk</p> <p>MLR4: <i>Information Gap</i> - Students share information to solve problems</p> <p>MLR5: <i>Co-Craft Questions</i> - Students create and improve questions</p> <p>MLR6: <i>Three Reads</i> - Students analyze complex mathematical text</p> <p>MLR7: <i>Compare and Connect</i> - Students connect different mathematical representations</p> <p>MLR8: <i>Discussion Supports</i> - Students participate in mathematical discussions</p> <p>In this unit:</p> <p>MLR1: Stronger and Clearer Each Time (Lessons 2, 5, 11, 14)</p> <p>MLR2: Collect and Display (Lessons 2, 6, 10, 12)</p> <p>MLR3: Clarify, Critique, Correct (Lessons 3, 14)</p> <p>MLR4: Information Gap (Lesson 18)</p> <p>MLR5: Co-Craft Questions (Lessons 4, 10, 18)</p>	

MLR6: Three Reads (Lessons 5, 9, 12, 15, 17, 18)
 MLR7: Compare and Connect (Lessons 1, 5, 8, 12, 13, 16)
 MLR8: Discussion Supports (Lessons 2, 6, 7, 12, 16, 18)

Sentence Frames and Stems

Section A

- _____ is the solution to the equation _____ because ...
- In this situation _____ represents a constraint because ... This means the solution must be _____.
- The equation _____ represents this situation because ...
- In the equation _____, the variable _____ represents _____ and has a value of _____.
- I used the point _____ on the graph to help me answer this question because ...

Section B

- To solve the equation _____ for _____ (variable), first I _____, then I ...
- The equation _____ is equivalent to the equation _____ because ...
- The equation _____ can be represented by the graph because ...
- On the graph of the line, the vertical/horizontal intercept of the line is _____. In this context the point represents ...
- I rearranged the equation _____ to the equivalent equation _____, and found the slope to be _____ which represents ...

Section C

- I know the system of equations has _____ solution(s) because ...
- I chose to solve this system of equations by _____ because ...
- To solve the system of equations, first I _____, then I ...
- On the graph, I can see the solution to the system is _____ because ...

Section D

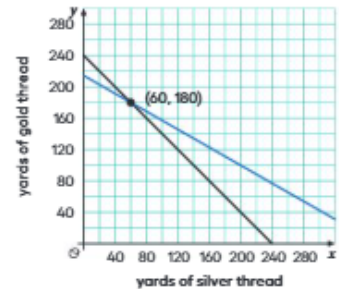
- The equation _____, paired with the given equation _____, creates a system with _____ solution(s) because ...
- To solve the equation _____ for _____ (variable), first I _____, then I ...

Unit Outline

In this unit, students examine solving and graphing linear equations and systems of linear equations.

The unit builds on learning from middle school when students used variables to write equations, manipulated equations using valid moves such as the distributive property, and solved basic systems of linear equations using graphs and substitution.

In the first section, students recall writing equations to represent situations. In the second section, they use valid moves to write equivalent equations that can be used to solve for unknown values or to isolate variables. The third section examines solving systems of equations using graphs, substitution for variables, and elimination of variables. Students use their understanding of writing equivalent equations to understand why each of the methods works for finding the solution.



Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
<p>Section A Writing and Modeling with Equations Lesson 1-5</p>	<p>Learning Target #1 I can interpret solutions to equations in one variable and in two variables.</p> <p>Learning Target #2 I can recognize that the graph of a linear equation in two variables represents all pairs of values that are solutions to the equation.</p>	<p>Lesson 1 Planning a Party</p> <ul style="list-style-type: none"> • I can explain the meaning of the term “constraints.” • I can tell which quantities in a situation can vary and which ones cannot. <p>Lesson 2 Writing Equations to Model Relationships (Part 1)</p> <ul style="list-style-type: none"> • I can tell which quantities in a situation can vary and which ones cannot. <div style="border: 1px solid red; padding: 5px;"> <p>Checkpoint A Problem 1 End of Unit Problem 4 <i>NOTES: End of Unit Problem 4</i> <i>Consider changing to a different scenario.</i> <i>Idea: Although you can buy an “8in” pizza, the cost structure is not “per inch” in real pizza shops.</i> <i>Option 1: Their experience buying pizza is sm, med, lg. Change the verbiage to sm, med, lg</i> <i>Option 2: Change the scenario to something where the cost structure is per inch</i> <i>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></p> </div>

		<ul style="list-style-type: none"> I can use letters and numbers to write expressions representing the quantities in a situation. Checkpoint A Problem 1 <p>Lesson 3 Writing Equations to Model Relationships (Part 2)</p> <ul style="list-style-type: none"> 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. <p>Lesson 4 Equations and Their Solutions</p> <ul style="list-style-type: none"> 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. <p>Lesson 5: Equations and Their Graphs (optional)</p> <ul style="list-style-type: none"> 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
Checkpoint A	<p><i>Responding to Student Thinking</i> More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time.</p>	
<p>Section B Manipulating Equations and Understanding Their Structure Lessons 6-11</p>	<p>Learning Target #3 I can determine the slope and vertical intercept of the graphs of linear equations by making use of structure or by rearranging the equations.</p> <p>Learning Target #4 I can rearrange multi-variable equations to highlight a particular quantity.</p> <p>Learning Target #5 I can recognize that “equivalent equations” are equations that have exactly the same solutions, and that multiple equivalent equations can represent the same relationship.</p>	<p>Lesson 6 Equivalent Equations</p> <ul style="list-style-type: none"> I can tell whether two expressions are equivalent and explain why or why not. Checkpoint B Problem 1 End of Unit Problem 1 <i>NOTES: End of Unit Problem 1</i> <i>Many students are unable to demonstrate that they understand legal moves because of the complexity of fractions.</i> <i>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> 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. <p>Lesson 7 Explaining Steps for Rewriting Equations</p> <ul style="list-style-type: none"> 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. <p>Lesson 8 Which Variable to Solve for? (Part 1)</p> <ul style="list-style-type: none"> 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.

		<p>Checkpoint B Problem 2 End of Unit Problem 2</p> <ul style="list-style-type: none"> I know the meaning of the phrase “to solve for a variable.” <p>Lesson 9 Which Variable to Solve for? (Part 2)</p> <ul style="list-style-type: none"> 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. <p>Checkpoint B Problem 2 End of Unit Problem 2</p> <ul style="list-style-type: none"> I know how solving for a variable can be used to quickly calculate the values of that variable. <p>Lesson 10 Connecting Equations to Graphs (Part 1)</p> <ul style="list-style-type: none"> 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. <p>Checkpoint B Problem 2 End of Unit Problem 3 <i>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></p> <ul style="list-style-type: none"> 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. <p>Lesson 11 Connecting Equations to Graphs (Part 2)</p> <ul style="list-style-type: none"> I can find the slope and vertical intercept of a line with equation $ax + by = c$ <p>Checkpoint B Problem C</p> <ul style="list-style-type: none"> 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.
Checkpoint B	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time. 	
<p>Section C Systems of Linear Equations in Two Variables Lessons 12-17</p>	<p>Learning Target #6 I can determine whether a system of equations will have 0, 1, or infinitely many solutions by analyzing their structure or by graphing.</p> <p>Learning Target #7 I can use elimination or substitution to create one or more equivalent systems to help solve the original system.</p>	<p>Lesson 12 Writing and Graphing Systems of Linear Equations</p> <ul style="list-style-type: none"> 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. <p>End of Unit Problem 5</p>

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 Solving Systems by Substitution

- 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 Solving Systems by Elimination (Part 1)

- 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 Solving Systems by Elimination (Part 2)

- 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 Solving Systems by Elimination (Part 3)

- 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

		<p>graph and solutions are the same as that of the original equation.</p> <p>Lesson 17 Systems of Linear Equations and Their Solutions</p> <ul style="list-style-type: none"> 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. <p style="border: 1px solid red; display: inline-block; padding: 2px;">Checkpoint C Problem 2</p> <ul style="list-style-type: none"> I know the possibilities for the number of solutions a system of equations could have.
Checkpoint C	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Points to Emphasize: If most students struggle to identify the number of solutions for a system of equations, plan to use all or part of this optional lesson: Algebra 1, Unit 2, Lesson 18 Asking About Solving Systems 	
<p>Section D Let's Put it to Work Lessons 18-19 SKIP</p>	<p>Learning Target #8 Analyze given information about a situation involving multiple linear equations, and determine what additional information is needed to solve problems.</p> <p>Learning Target #9 Create a pattern using linear equations.</p> <p>Learning Target #10 Solve, without graphing, systems of equations created by peers.</p>	<p>Lesson 18 Asking About Solving Systems</p> <ul style="list-style-type: none"> I can get more information about a problem in order to write and solve a system of linear equations. I can solve linear equations algebraically. I can write linear equations to create a pattern. <p>Lesson 19 Linear Patterns</p> <ul style="list-style-type: none"> I can get more information about a problem in order to write and solve a system of linear equations. I can solve linear equations algebraically. I can write linear equations to create a pattern.
End of Unit Assessment		

Unit Title:			
Unit 3: Linear Inequalities and Systems (iM U4)			
Relevant Standards: Bold indicates priority			
	Lesson	Standards	Lesson
	Lesson 1	HSA-CED.A.3	Lesson 6
	Lesson 2	HSA-REI.B.3	Lesson 7
	Lesson 3	HSA-CED.A.1HSA-CED.A.3HSA-REI.B.3	Lesson 8
	Lesson 4	HSA-REI.D.12	Lesson 9
	Lesson 5	HSA-CED.A.3HSA-REI.D.10HSA-REI.D.12	
			HSA-CED.A.3HSA-REI.D.12
			HSA-CED.A.3HSA-REI.D.12
			HSA-REI.D.12
			HSA-CED.A.3HSA-REI.D.12HSN-Q.A.2
Essential Question(s):		Enduring Understanding(s):	
<ul style="list-style-type: none"> 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? 		<ul style="list-style-type: none"> 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	
CFA 1: Checkpoint A (after Lesson 3) CFA 2: Checkpoint B (after Lesson 6) Checkpoint C (after lesson 9): Opportunity for feedback End of Unit Assessment A (after lesson 19)		13 Days Lesson to Review/Add: <ul style="list-style-type: none"> 7.6.13 7.6.15 Lesson Modifications: <ul style="list-style-type: none"> Lesson 9: Complete outside of class. 	
Family Overview		Integration of Technology:	
https://accessim.org/9-12-aga/algebra-1/unit-4?a=family		<ul style="list-style-type: none"> Desmos Online Graphing Calculator Pear Assessment (Edulastic) iM v.360 Digital Applets (see below) 	
Unit-specific Vocabulary:		Aligned Unit Materials, Resources, and Technology	
Solution set, Half-plane, Boundary line, Dashed line, Solid line, Shaded region, System of linear inequalities, Solution region, Constraint, Viable solution, Nonviable solution, Equivalent inequalities, Related equation		Digital Applets <ul style="list-style-type: none"> Alg1.4.2 Digital Activity: More or Less? Provide access as needed throughout the unit: <ul style="list-style-type: none"> Colored pencils Graphing technology Math Community Chart Tools for creating a visual display (Any way for students to create work that can be easily displayed to the class. Examples: Chart paper and markers, whiteboard space and markers, shared online drawing tool, access to a document camera.) 	
		Lessons	Materials to Gather
			Materials to Copy

	4 Colored pencils: Activity 1	
	6 Graphing technology: Warm-up, Activity 1	Representations of Inequalities Cards (1 copy for every 2 students): Activity 2
	7 Graphing technology: Warm-up, Activity 1, Activity 2	
	8 Math Community Chart: Activity 2	Terms of A Team Cards (1 copy for every 2 students): Activity 2
	9 Graphing technology: Activity 2 Tools for creating a visual display: Activity 2	
Opportunities for Interdisciplinary Connections:	Anticipated misconceptions:	
<p>Science (Physics)</p> <ul style="list-style-type: none"> 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) <p>Social Studies</p> <ul style="list-style-type: none"> Students create a monthly budget by writing equations 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. <p>Health & PE</p> <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 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. <p>See teacher's guide for specific misconceptions aligned to each lesson.</p>	
Connections to Prior Units:	Connections to Future Units:	
<p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> Solve inequalities by reasoning about quantities Solve linear equations and systems of equations by writing equivalent equations. <p>Relevant Unit(s)/Lesson(s) to Review:</p> <ul style="list-style-type: none"> Grade 7 Unit 6: Expressions, Equations, and Inequalities 	<p>Connection to Unit 3: Linear Inequalities and Systems</p> <ul style="list-style-type: none"> 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 <p>Connection to Unit 4: Functions</p> <ul style="list-style-type: none"> 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 <p>Connection to Unit 5: Exponential Functions</p> <ul style="list-style-type: none"> 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*

Engagement:

- Encourage peer interaction and provide sentence frames for constraint modeling
- (Lesson 7, Activity 1 Launch)

Representation:

- Use diagrams to visualize "at most" or "at least" constraints
- (Lesson 3, Activity 1 Student Task Statement)

Action & Expression:

- Invite students to plan strategies and choose appropriate tools before testing solutions
- (Lesson 8, Activity 1 Launch)

Supporting Multilingual Learners

Math Language Routines

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
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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

In this unit:

- MLR2: Collect and Display (Lesson 1)
- MLR4: Information Gap (Lesson 8)
- MLR5: Co-Craft Questions (Lessons 2, 3)
- MLR6: Three Reads (Lessons 1, 5, 7, 9)
- MLR7: Compare and Connect (Lessons 3, 6, 9)
- MLR8: Discussion Supports (Lessons 2, 4, 7, 8)

Sentence Frames and Stems

Section A

- The related equation _____ helped me see that _____ is/is not a solution to the inequality _____ because ...
- The value _____ is/is not a solution to the inequality _____ because ...
- The inequality _____ represents this situation because ...
- To solve the inequality for all possible values of _____, first I _____, then I ...

Section B

- The inequality _____ represents this situation because ...
- The point _____ is/is not a solution to the inequality because ...
- To graph the solution to the inequality _____, first I _____, then I ...

Section C

- The pair of values _____ is a solution to the system of inequalities _____ because ...
- I noticed that ... This means that the system of inequalities _____ has _____ solution(s).
- The system of inequalities _____ represents this situation because ...

Unit Outline

In this unit, students examine solving and graphing linear inequalities and systems of linear inequalities.

The unit builds on concepts from middle school when students write and solve inequalities by reasoning about quantities. It further builds on concepts from an earlier unit in which students solve linear equations and systems of equations by writing equivalent equations.

To start, students solve linear inequalities in one variable and graph the solutions on a number



line by writing equivalent inequalities. In the second section, they solve linear inequalities with two variables by looking at the related equation, graphing it on a coordinate plane, and testing points on either side of the line to determine the solution region. The third section is about solving systems of linear inequalities considering multiple linear inequalities as conditions for situations and finding a solution region that satisfies all of the inequalities.

Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
<p>Section A: Linear Inequalities in One Variable Lessons 1-3</p>	<p>Learning Target #1 Use a related equation to solve an inequality in one variable.</p> <p>Learning Target #2 Write and solve inequalities in one variable to represent the constraints in situations and to solve problems.</p>	<p>Lesson 1 Representing Situations with Inequalities</p> <ul style="list-style-type: none"> I can write inequalities that represent the constraints in a situation. <p>Lesson 2 Solutions to Inequalities in One Variable</p> <ul style="list-style-type: none"> I can graph the solution to an inequality in one variable. I can solve one-variable inequalities and interpret the solutions in terms of the situation. I understand that the solution to an inequality is a range of values (such as $x > 7$) that makes the inequality true. <p>Lesson 3 Writing and Solving Inequalities in One Variable</p> <ul style="list-style-type: none"> 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.
<p>Checkpoint A</p>	<p><i>Responding to Student Thinking</i> Points to Emphasize: If students struggle to solve and graph an inequality in 1 variable, provide additional practice throughout the unit. For example, use the practice problems referred to here to discuss solutions. Algebra 1, Unit 4, Lesson 4, Practice Problem 10 Algebra 1, Unit 4, Lesson 5, Practice Problem 7 More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time.</p>	
<p>Section B: Linear Inequalities in Two Variables Lessons 4-6</p>	<p>Learning Target #3 Understand that a constraint on two variables can be represented by an inequality, a graph (a half-plane), and a verbal description.</p> <p>Learning Target #4 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.</p>	<p>Lesson 4 Graphing Linear Inequalities in Two Variables (Part 1)</p> <ul style="list-style-type: none"> 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. <p>Lesson 5 Graphing Linear Inequalities in Two Variables (Part 2)</p> <ul style="list-style-type: none"> 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. I can find the solutions to a two-variable inequality by using the graph of a related two-variable equation. I can write inequalities to describe the constraints in a situation. <p>Lesson 6 Solving Problems with Inequalities in Two Variables</p> <ul style="list-style-type: none"> 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..
<p>Checkpoint B</p>	<p><i>Responding to Student Thinking</i> More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time.</p>	
<p>Section C: Systems of Linear Inequalities in Two Variables Lessons 7-9</p>	<p>Learning Target #5 Given a system of inequalities and their graphs, explain how to tell if a pair of values is a solution to the system.</p>	<p>Lesson 7 Solutions to Linear Systems of Inequalities in Two Variables</p> <ul style="list-style-type: none"> I can write a system of inequalities to describe a situation, find the solution by graphing, and interpret points in the solution.

	<p>Learning Target #6 Understand that the solution set of a system of 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.</p>	<ul style="list-style-type: none"> • I know what is meant by "the solutions to a system of inequalities" and can describe the graphs that represent the solutions. • 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. <p>Lesson 8 Solving Problems with Systems of Linear Inequalities in Two Variables</p> <ul style="list-style-type: none"> • 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. <p>Lesson 9 Modeling with Systems of Inequalities in Two Variables</p> <ul style="list-style-type: none"> • 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	<p><i>Responding to Student Thinking</i> Points to Emphasize: If students struggle to write a system of inequalities to represent the situation, consider using modeling prompts to help students identify variables and write relationships. For example, in the referred-to modeling prompt, students might use inequalities to write a system involving a worker's annual salary (Algebra 1, Modeling prompt: Giving Bonuses)</p>	
End of Unit Assessment		

Unit Title:**Unit 4: Functions (iM U5)****Relevant Standards: Bold indicates priority**

Lesson	Standards	Lesson	Standards
Lesson 1	HSF-IF.A.1, HSF-IF.B.4	Lesson 10	HSF-IF.B, HSF-IF.B.5
Lesson 2	HSF-IF.A.1, HSF-IF.A.2, HSF-IF.B.4	Lesson 11	HSF-IF.B.4, HSF-IF.B.5
Lesson 3	HSF-IF.A.2, HSF-IF.B.4	Lesson 12	HSF-IF.A.2, HSF-IF.B.5, HSF-IF.C, HSF-IF.C.7, HSF-IF.C.7.b
Lesson 4	HSF-BF.A.1.a, HSF-IF.A.1, HSF-IF.A.2, HSF-IF.B.4, HSF-IF.C	Lesson 13	HSA-CED.A.1, HSF-IF.C, HSF-IF.C.7.b
Lesson 5	HSA-REI.A.1, HSF-IF.A.2, HSF-IF.B.4	Lesson 14	HSF-BF.A.1, HSF-BF.A.1.a, HSF-BF.B.3, HSF-IF.C, HSF-IF.C.7.b
Lesson 6	HSF-IF.B.4	Lesson 15	HSF-BF.B.4
Lesson 7	HSF-IF.B.6	Lesson 16	HSA-CED.A.4, HSF-BF.B.4
Lesson 8	HSF-IF.B.4, HSF-IF.B.6	Lesson 17	HSF-BF.A.1, HSF-BF.B.4, HSF-BF.B.4.a, HSF-IF.A.2, HSF-IF.B.4, HSS-ID.B.6.a, HSS-ID.B.6.c
Lesson 9	HSA-REI.D.11, HSF-IF.B.4, HSF-IF.B.6	Lesson 18	HSF-BF.A.1, HSF-IF.B.6, HSS-ID.B.6.a, HSS-ID.B.6.c

Essential Question(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?

Enduring Understanding(s):

- **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:

Checkpoint A (after Lesson 5): Opportunity for Feedback
 CFA 1: Checkpoint B (after Lesson 9)
 Mid-unit Assessment (after Lesson 9)
 Checkpoint C (after Lesson 12): Opportunity for Feedback
 CFA 2: Checkpoint D (after Lesson 16)
 Checkpoint E (after lesson 19): Opportunity for Feedback
 End-of-Unit Assessment (after Lesson 20)

Pacing for Unit**24 Days**

Lessons to Add/Review:

- 8.5.2
- 8.5.3

Lesson Modifications:

- Combine Lessons 13 and 14, by completing Lesson 14 Activities 2 and 3 outside of class.
- Lesson 18: Complete outside of class.

Family Overview

<https://accessim.org/9-12-aga/algebra-1/unit-5?a=family>

Integration of Technology:

- Desmos Online Graphing Calculator
- Pear Assessment (Edulastic)
- iM v.360 Digital Applets (see below)

Unit-specific Vocabulary:	Aligned Unit Materials, Resources, and Technology																														
<p>Dependent variable, independent variable, function, function notation, linear function, maximum, minimum, horizontal intercept, vertical intercept, average rate of change, domain, range, piecewise function, absolute value, vertex, inverse function</p>	<p>Digital Applets</p> <ul style="list-style-type: none"> Alg1.5.5 Digital Activity 2: Function Notation and Graphing Technology Alg1.5.8 Digital Activity: Flag Raising (Part 1): Are You Ready for More? Alg1.5.14 Digital Activity 2: Moving Graphs Around <p>Provide access as needed throughout the unit:</p> <ul style="list-style-type: none"> Blank paper Glue or glue sticks Graphing technology Math Community Chart Scientific calculators <table border="1" data-bbox="812 556 1526 1438"> <thead> <tr> <th>Lessons</th> <th>Materials to Gather</th> <th>Materials to Copy</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>Graphing technology: Activity 2</td> <td></td> </tr> <tr> <td>10</td> <td></td> <td>Possible or Impossible Cards (1 copy for every 2 students): Activity 1</td> </tr> <tr> <td>12</td> <td> <ul style="list-style-type: none"> Blank paper: Activity 3 Glue or glue sticks: Activity 3 </td> <td>Piecing It Together Cards (1 copy for every 2 students): Activity 3</td> </tr> <tr> <td>13</td> <td></td> <td>How Good Are Your Guesses Handout (1 copy for every 1 student): Activity 1</td> </tr> <tr> <td>14</td> <td>Graphing technology: Activity 3</td> <td></td> </tr> <tr> <td>15</td> <td>Scientific calculators: Lesson</td> <td></td> </tr> <tr> <td>17</td> <td>Scientific calculators: Lesson</td> <td>Caesar Says, "Shift" Cutouts (1 copy for every 2 students): Activity 2</td> </tr> <tr> <td>18</td> <td>Math Community Chart: Activity 2</td> <td>Custom Mugs Cards (1 copy for every 2 students): Activity 2</td> </tr> <tr> <td>19</td> <td> <ul style="list-style-type: none"> Scientific calculators: Activity 1 Graphing technology: Activity 3 </td> <td></td> </tr> </tbody> </table>	Lessons	Materials to Gather	Materials to Copy	6	Graphing technology: Activity 2		10		Possible or Impossible Cards (1 copy for every 2 students): Activity 1	12	<ul style="list-style-type: none"> Blank paper: Activity 3 Glue or glue sticks: Activity 3 	Piecing It Together Cards (1 copy for every 2 students): Activity 3	13		How Good Are Your Guesses Handout (1 copy for every 1 student): Activity 1	14	Graphing technology: Activity 3		15	Scientific calculators: Lesson		17	Scientific calculators: Lesson	Caesar Says, "Shift" Cutouts (1 copy for every 2 students): Activity 2	18	Math Community Chart: Activity 2	Custom Mugs Cards (1 copy for every 2 students): Activity 2	19	<ul style="list-style-type: none"> Scientific calculators: Activity 1 Graphing technology: Activity 3 	
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Opportunities for Interdisciplinary Connections:	Anticipated misconceptions:																														
<p>Science (Physical Science, Earth Science)</p> <ul style="list-style-type: none"> In physical science, students learn about speed, velocity, and acceleration—concepts that can be modeled with linear functions. 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. <p>Social Studies /Civics</p> <ul style="list-style-type: none"> Functions apply to economic trends, such as tracking the relationship between minimum wage and employment rates or supply and demand. <p>Health & PE</p> <ul style="list-style-type: none"> In PE, students could model heart rate during exercise, where different stages (rest, exercise, recovery) are modeled with a piecewise function. 	<ul style="list-style-type: none"> 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 <p>See teacher's guide for specific misconceptions aligned to each lesson.</p>																														

<p>Visual Arts and Music</p> <ul style="list-style-type: none"> • Transformations of graphs (shifts, reflections, stretches) tie directly to transformations in art (moving shapes on a canvas or stretching images). <p>Career and Technical Education</p> <ul style="list-style-type: none"> • In business, students can create profit functions that model how income changes based on sales. • In construction or engineering, students can graph relationships like material costs vs. project size. 	
<p>Connections to Prior Units:</p> <p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> • Understand the meaning of function as a rule with exactly one output for each allowable input. • Understand independent and dependent variables and how they relate to functions. <p>Relevant Unit(s)/Lesson(s) to Review:</p> <p>Grade 7 Bridge</p> <ul style="list-style-type: none"> • Unit 9: Functions and Volume (G7 ACC U6) 	<p>Connections to Future Units:</p> <p>Connection to Unit 4: Functions</p> <ul style="list-style-type: none"> • 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 <p>Connection to Unit 5: Exponential Functions</p> <ul style="list-style-type: none"> • 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 <p>Connection to Unit 6: Quadratic Functions</p> <ul style="list-style-type: none"> • 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
<p>Differentiation through <i>Universal Design for Learning</i></p>	
<p>Engagement:</p> <ul style="list-style-type: none"> • Support peer collaboration through sentence frames during function discussions (Lesson 3, Activity 1 Launch) <p>Representation:</p> <ul style="list-style-type: none"> • Use physical objects (like a 3D prop for a dog's leash) to model movement (Lesson 1, Activity 1 Launch) <p>Action & Expression:</p> <ul style="list-style-type: none"> • Provide a blank two-column table to organize information before modeling (Lesson 20, Activity 2 Student Task Statement) 	
<p>Supporting Multilingual Learners</p>	
<p>Math Language Routines</p> <p>The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners:</p> <p>MLR1: <i>Stronger and Clearer Each Time</i> - Students revise and refine their mathematical language through multiple drafts</p> <p>MLR2: <i>Collect and Display</i> - Students capture and organize language in visual displays</p> <p>MLR3: <i>Clarify, Critique, Correct</i> - Students analyze mathematical writing/talk</p> <p>MLR4: <i>Information Gap</i> - Students share information to solve problems</p> <p>MLR5: <i>Co-Craft Questions</i> - Students create and improve questions</p> <p>MLR6: <i>Three Reads</i> - Students analyze complex mathematical text</p> <p>MLR7: <i>Compare and Connect</i> - Students connect different mathematical representations</p> <p>MLR8: <i>Discussion Supports</i> - Students participate in mathematical discussions</p> <p>In this unit:</p> <ul style="list-style-type: none"> • MLR1: Stronger and Clearer Each Time (Lessons 7, 8, 12, 14, 15, 20) • MLR2: Collect and Display (Lessons 2, 9, 11, 12, 13, 17) • MLR3: Clarify, Critique, Correct (Lesson 2) • MLR4: Information Gap (Lessons 14, 18) • MLR5: Co-Craft Questions (Lessons 6, 9, 19) • MLR6: Three Reads (Lessons 1, 13, 17) • MLR7: Compare and Connect (Lessons 8, 13, 18, 20) • MLR8: Discussion Supports (Lessons 1, 4, 5, 9, 10, 11, 12, 14, 18, 19) 	

Sentence Frames and Stems

Section A

- In the function _____, the independent variable is _____ because ... and the dependent variable is _____ because ...
- The function _____ represents this situation/graph because ...
- The value of the output is _____ when the input is _____, and can be represented in function notation as _____.

Section B

- On the graph, the average rate of change of the function from _____ to _____ is _____.
- Between _____ and _____, the _____ is _____.
- The value(s) of the _____ (feature of the graph) is/are _____.
- For the function _____, the value of the output is _____ when the input is _____.
- To sketch a graph of _____, I thought about _____, which meant I should draw ...

Section C

- In this situation, the rule is _____ which means the input is _____ to get the output.
- _____ is a/n possible/impossible input because ...
- The domain of the function is _____ because ...
- The range of the function is _____ because ...

Section D

- The domain/range of the absolute value function _____ is _____ because ...
- The function _____ represents this situation/graph because ...
- For the function _____, the value of the output is _____ when the input is _____.
- The solution(s) to the equation _____ is/are _____.

Section E

- The equation _____ represents the inverse function of the relationship between _____ and _____ because ...
- The inverse function _____ is helpful in this situation because ...
- To get the inverse function, first I _____, then I ...

Section F

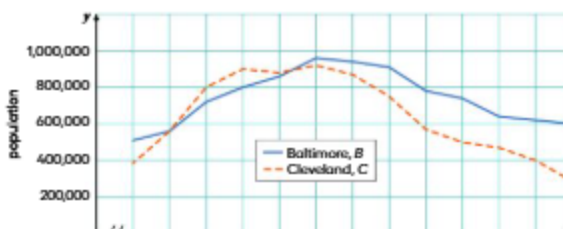
- I used the equation _____ to model the situation because ...
- I changed my prediction from _____ to _____ because ...
- The average rate of change between _____ and _____ is _____ which means ...

Unit Outline

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.

Then, students explore graphs of functions to describe features such as “maximum,” “minimum,” “intercepts,” “increasing,” “decreasing,” and “average rate of change” and make connections between the graphs and real-life situations.

They use situations to discuss the domain and range of a function and make sense of piecewise-defined functions. In particular, students examine the absolute value function and some basic transformations of it. Later, students explore inverses of linear functions as a way to find corresponding input values when output values are known. Throughout the unit, students have chances to mathematically model real-world situations.



Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
Section A: Functions and Their Representations Lessons 1-5	Learning Target #1 Sketch a graph of a function given statements in function notation. Learning Target #2 Understand that a relationship between two quantities is a function if there is only one possible output for each input. Learning Target #3 Write equations that represent rules using function notation.	Lesson 1 Describing and Graphing Situations <ul style="list-style-type: none"> • I can explain when a relationship between two quantities is a function. Checkpoint A Problem 1 <i>NOTES: Checkpoint A Problem 1</i> <i>Consider changing the scenarios to more student friendly relationship</i> • 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 Function Notation <ul style="list-style-type: none"> • I can use function notation to express functions that have specific inputs and outputs.

		<ul style="list-style-type: none"> 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. <p>Middle of Unit Problem 1 Middle of Unit Problem 4</p> <p>Lesson 3 Interpreting and Using Function Notation</p> <ul style="list-style-type: none"> I can describe the connections between a statement in function notation and the graph of the function. <p>Middle of Unit Problem 2 Middle of Unit Problem 5 Checkpoint B Problem 1</p> <ul style="list-style-type: none"> I can use function notation to efficiently represent a relationship between two quantities in a situation. <p>Checkpoint B Problem 2 <i>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></p> <ul style="list-style-type: none"> I can use statements in function notation to sketch a graph of a function. <p>Lesson 4 Using Function Notation to Describe Rules (Part 1)</p> <ul style="list-style-type: none"> I can make sense of rules of functions when they are written in function notation, and create tables and graphs to represent the functions. <p>Middle of Unit Problem 6</p> <ul style="list-style-type: none"> I can write equations that represent the rules of functions. <p>Checkpoint A Problem 2 Middle of Unit Problem 4 Middle of Unit Problem 6 <i>NOTES: Middle of Unit Problem 6 Students need more exposure to situations like this example with rice.</i></p> <p>Lesson 5 Using Function Notation to Describe Rules (Part 2)</p> <ul style="list-style-type: none"> 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.
Checkpoint A	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Question 1: Points to Emphasize If students struggle to determine if the relationships are functions, reinforce the idea throughout the unit. For example, as students work with functions in the lesson referred to here, ask students why the relationships are functions and to provide a similar relationship that is not a function. Algebra 1, Unit 5, Lesson 6 Features of Graphs Question 2: More Chances Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time. 	
<p>Section B: Analyzing and Creating Graphs of Functions Lessons 6-9</p>	<p>Learning Target #4 Given a graph of a function, estimate or calculate the average rate of change over a specified interval.</p> <p>Learning Target #5 Interpret key features of a graph—the intercepts, maximums, minimums, and intervals when the function is increasing or decreasing—in terms of a situation.</p>	<p>Lesson 6 Features of Graphs</p> <ul style="list-style-type: none"> I can identify important features of graphs of functions and explain what they mean in the situations represented. <p>Middle of Unit Problem 3</p> <ul style="list-style-type: none"> I understand and can use the terms “horizontal intercept,” “vertical intercept,” “maximum,” and “minimum” when talk about functions and their graphs. <p>Checkpoint B Problem 1 Middle of Unit Problem 3</p> <p>Lesson 7 Using Graphs to Find Average Rate of Change</p> <ul style="list-style-type: none"> I understand the meaning of the term “average rate of change.” <p>Middle of Unit Problem 7</p>

	<p>Learning Target #6 Interpret statements about two or more functions written in function notation.</p>	<p style="border: 1px solid red; padding: 2px;"><i>NOTE: Middle of Unit Problem 7 Make Part b. one year and not an interval of years.</i></p> <ul style="list-style-type: none"> 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 <p>Lesson 8 Interpreting and Creating Graphs</p> <ul style="list-style-type: none"> 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. <p>Lesson 9 Comparing Graphs</p> <ul style="list-style-type: none"> 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 $y = mx + b$ 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.
<p>Checkpoint B</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Points to Emphasize: If students struggle to identify important features of a graph, revisit the ideas whenever graphs are used throughout the rest of the unit. For example, in the activity referred to here, ask students about maxima, minima, and intercepts. Algebra 1, Unit 5, Lesson 11, Activity 2 Back to the Bouncing Ball Problem 2: Points to Emphasize: If students struggle to write an expression for average rate of change, revisit the idea by asking students to compute the average rate of change for particular intervals of functions. For example, in the Warm-up of the activity referred to here, ask about the average rates of change from 0 to 8 ounces, 8 to 12 ounces, and 0 to 12 ounces, and note the difference in the context of piecewise functions. Algebra 1, Unit 5, Lesson 12, Warm-up Frozen Yogurt 	
<p>Section C: A Closer Look at Inputs and Outputs Lessons 10-14</p>	<p>Learning Target #7 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.</p> <p>Learning Target #8 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.</p> <p>Learning Target #9 Understand that the domain of a function is the set of all possible inputs and the range is the set of all possible outputs.</p>	<p>Lesson 10 Domain and Range (Part 1)</p> <ul style="list-style-type: none"> I know what is meant by the “domain” and “range” of a function. Checkpoint C Problem 1 <i>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.</i> Checkpoint C Problem 2 <i>NOTE: Checkpoint C Problem 2 Same issue as Problem 1. Students have not determined domain and range from a piecewise function.</i> 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 <i>NOTE: End of Unit Problem 1: The graph is misleading to determine the range.</i> <p>Lesson 11 Domain and Range (Part 2)</p> <ul style="list-style-type: none"> 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

		<p style="border: 1px solid red; padding: 2px;">Checkpoint C Problem 2</p> <p>Lesson 12 Piecewise Functions</p> <ul style="list-style-type: none"> 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. <p style="border: 1px solid red; padding: 2px;">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</p> <ul style="list-style-type: none"> 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. <p style="border: 1px solid red; padding: 2px;">Checkpoint C Problem 2 End of Unit Problem 5</p> <ul style="list-style-type: none"> I understand what makes a function a piecewise function. <p>Lesson 13 Absolute Value Functions (Part 1)</p> <ul style="list-style-type: none"> Given a set of numerical guesses and a target number, I can calculate absolute errors and create a scatter plot of the data. <p style="border: 1px solid red; padding: 2px;">End of Unit Problem 2</p> <ul style="list-style-type: none"> 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. <p style="border: 1px solid red; padding: 2px;">End of Unit Problem 2</p> <p>Lesson 14 Absolute Value Functions (Part 2)</p> <ul style="list-style-type: none"> I can describe the effects of adding a number to the expression that defines an absolute value function. <p style="border: 1px solid red; padding: 2px;">Checkpoint C Problem 1 End of Unit Problem 3</p> <ul style="list-style-type: none"> 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.
Checkpoint C	<i>Responding to Student Thinking</i>	<ul style="list-style-type: none"> Points to Emphasize: If students struggle to describe the domain and range of the function, revisit this idea using the functions throughout the rest of the unit. For example, in the activity referred to here, ask students what a reasonable domain and range might be for temperatures in the area in the two measurement systems. Algebra 1, Unit 5, Lesson 18, Activity 1 From Celsius to Fahrenheit
Mid-Unit Assessment		

<p>Section D: Inverse Functions Lessons 15 - 19</p>	<p>Learning Target #10 Find the inverse of a linear function by solving an equation for the input variable.</p> <p>Learning Target #11 Write a linear function and an inverse function to model data and solve problems.</p>	<p>Lesson 15 Solving Equations with Absolute Values</p> <ul style="list-style-type: none"> 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 <p>Lesson 16 Solving Inequalities with Absolute Values</p> <ul style="list-style-type: none"> 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 <p>Lesson 17 Inverse Functions</p> <ul style="list-style-type: none"> 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 <p>Lesson 18 Finding and Interpreting Inverse Functions</p> <ul style="list-style-type: none"> I can use functions to model data and make predictions. <p>Lesson 19 Writing Inverse Functions to Solve Problems</p> <ul style="list-style-type: none"> 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.
<p>Checkpoint D</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Press Pause: If students struggle to graph the absolute value function, make time to revisit how to transform a graph by looking at the function. For example, use the practice problems referred to here to provide additional practice. Algebra 1, Unit 5, Lesson 14, Practice Problem 2 Algebra 1, Unit 5, Lesson 14, Practice Problem 4 Problem 2: Press Pause: If students struggle to solve absolute value equations and inequalities, and it is an important standard for the course, make time to revisit the different methods for solving. For example, use the practice problems referred to here to provide additional practice. Algebra 1, Unit 5, Lesson 16, Practice Problem 2 Algebra 1, Unit 5, Lesson 15, Practice Problem 5 	
<p>Section E: Let’s Put It to Work Lesson 20</p>	<p>Learning Target #12 Use functions to model real-life situations and make predictions.</p>	<p>Lesson 20: Using Functions to Model Battery Power</p> <ul style="list-style-type: none"> Let’s use functions to model data and make predictions.
<p>End of Unit Assessment</p>		

Unit Title:**Unit 5: Exponents and Scientific Notation (G8 U7)****Relevant Standards: Bold indicates priority**

Lesson	Standards	Lesson	Standards
Lesson 1	None Listed	Lesson 9	8.EE.A.3
Lesson 2	8.EE.A.1	Lesson 10	8.EE.A.3,8.EE.A.4
Lesson 3	8.EE.A.1	Lesson 11	8.EE.A.1, 8.EE.A.3, 8.EE.A.4
Lesson 4	8.EE.A.1	Lesson 12	8.EE.A.3, 8.EE.A.4
Lesson 5	8.EE.A.1	Lesson 13	8.EE.A.4
Lesson 6	8.EE.A.1	Lesson 14	8.EE.A.1, 8.EE.A.3, 8.EE.A.4
Lesson 7	8.EE.A.1	Lesson 15	8.EE.A.4
Lesson 8	8.EE.A.1	Lesson 16	8.EE.A.3, 8.EE.A.4

Essential Question(s):

- How can we use exponents to describe repeated multiplication more efficiently?
- What does the exponent tell us, and what does the base tell us?
- Why does a number raised to the power of 0 equal 1?
- When we multiply powers with the same base, what happens to the exponents, and why?
- How are the rules for multiplying and dividing powers related?
- What does it mean to raise a power to another power?
- How do exponent rules help us rewrite expressions in simpler or more useful forms?
- What does a negative exponent actually mean, and how is it different from a negative number?
- How can we use powers of 10 to represent very large and very small numbers?
- How can a number line help us understand the relationships between powers of 10?
- What is scientific notation, and why is it a useful way to represent numbers?
- How can we use scientific notation and estimation to compare or analyze real-world quantities?

Enduring Understanding(s):

- Exponents provide an efficient notation for repeated multiplication, where the base represents the factor being multiplied and the exponent represents how many times it is multiplied.
- The rules for operating with exponents (product rule, quotient rule, power of a power) are not arbitrary shortcuts—they emerge logically from the fundamental properties of multiplication and can be verified by expanding expressions.
- A negative exponent indicates division (or taking a reciprocal), not a negative quantity. The expression a^{-n} means $\frac{1}{a^n}$, and this definition extends the exponent rules consistently.
- Any large or small number can be expressed as a multiple of a power of 10. This equivalence allows us to move fluidly between standard form, exponential expressions, and scientific notation, and helps us compare and estimate quantities of different magnitudes.
- Scientific notation (writing a number as $ax10^n$ where $1 \leq a < 10$) is a universal standard that allows us to represent, compare, and compute with very large and very small numbers efficiently. It makes the magnitude of numbers transparent and computation manageable.

Demonstration of Learning:

Checkpoint A (after lesson 5): Opportunity for Feedback
 CFA 1: Checkpoint B (after lesson 8)
 Checkpoint C (after lesson 12): Opportunity for Feedback
 CFA 2: Checkpoint D (after lesson 15)
 EoU: Assessment A (after lesson 16)

Pacing for Unit**20 Days**

Lessons to Add/Review:

- None

Lesson Modifications:

- Move to outside of class 8.7.16: culminating lesson incorporating work from the unit

Family Overview

<https://accessim.org/6-8/grade-8/unit-7?a=family>

Integration of Technology:

- Desmos Online Graphing Calculator
- Pear Assessment (Edulastic)
- iM v.360 Digital Applets (see below)

Unit-specific Vocabulary:

Base (of an exponent), exponent, reciprocal, scientific notation

Aligned Unit Materials, Resources, and Technology

Digital Applets

- 8.7.1 Activity 2: Doubling Coins
- 8.7.2 Activity 2 Applet: Zoom
- 8.7.10 Activity 1 & 2 Applets: Comparing Large Numbers with a Number Line, The Speeds of Light

	Provide access as needed throughout the unit: <ul style="list-style-type: none"> • Blank paper • Math Community Chart • Tools for creating a visual display 	
	Lesson	Materials to Gather
	8	Tools for creating a visual display: Activity 2
	9	Using Powers of 10 to Describe Cards (1 copy for every 6 students): Activity 2
	12	Math Community Chart: Activity 1
	13	Blank paper
	14	Distances in the Solar System Cards (1 copy for every 4 students): Activity 2
	16	Old Hardware New Hardware Handout (1 copy for every 2 students): Activity 1

Opportunities for Interdisciplinary Connections:	Anticipated misconceptions:
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<p>Chemistry & Atomic Structure</p> <ul style="list-style-type: none"> • Lesson connection: Lessons 5 and 11 focus on negative exponents and very small numbers, providing foundational understanding for chemistry contexts. <p>Earth Science</p> <ul style="list-style-type: none"> • Lesson connection: Lessons 12-15 apply scientific notation to real-world measurement and comparison situations. <p>Reading Scientific Texts</p> <ul style="list-style-type: none"> • Orders of magnitude reasoning: Articles often describe quantities as "thousands," "millions," or "billions." Students connect these verbal descriptions to scientific notation and understand relative sizes. • Lesson connection: Lesson 14 on estimating with scientific notation prepares students to read and understand these texts critically. <p>Measurement and Estimation in Medical and Health Contexts</p> <p>Dosing & Pharmacology</p> <ul style="list-style-type: none"> • Medication dosages: Some medications are dosed in micrograms (grams) or nanograms (grams) per kilogram of body weight. Students use negative exponents and scientific notation to calculate appropriate doses. • Lesson connection: Lessons 11-15 support calculations with very small quantities expressed in scientific notation. 	<ul style="list-style-type: none"> • Students may confuse different exponent rules (mixing up the product rule and power of a power rule) • Overgeneralization from procedures they've learned (if multiplication is involved, multiply all numbers) • The same rule applies whether you're multiplying or raising to a power • Confusion about parentheses and what they mean • Since division is the opposite of multiplication, maybe division of exponents is the opposite operation (divide instead of add) • Overgeneralization: "divide the numbers" without thinking about what exponents represent • The negative sign in the exponent makes the result negative • 10^{-3} is the "opposite" of 10^3, meaning it's negative • Confusion between 10^{-3} and -10^3 • Exponent of 0 means "nothing," so the answer is 0 • Any way of writing a number as a power of 10 is acceptable • They may not understand that scientific notation has a specific, standardized form • Not recognizing that addition requires like terms • Confusion about how negative exponents relate to decimal place movement • Incorrect direction of decimal movement (moving right instead of left, or vice versa) or amount of movement • The base determines the size, not the exponent • A large exponent doesn't matter if the base is small <p>See teacher's guide for specific misconceptions aligned to each lesson.</p>
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Connections to Prior Units:	Connections to Future Units:
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<p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> • Expressions that have positive whole-number exponents and whole-number, fraction, or variable bases 	<p>Algebra Unit 6- Introduction to Exponential Functions.</p>
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Relevant Unit(s)/Lesson(s) to Review:	
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- Grade 6 Unit 6: Expressions and Exponents

Differentiation through *Universal Design for Learning*

Representation:

- Access for Perception by reading problems aloud to partners for extra processing time (Lesson 16, Activity 2 Launch)

Action & Expression:

- Chunk tasks and support use of structure when deciding which power of 10 to use (Lesson 11, Activity 2 Launch)

Supporting Multilingual Learners

Math Language Routines

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

In this unit:

- MLR1: Stronger and Clearer Each Time (Lesson 8)
- MLR2: Collect and Display (Lessons 2, 3, 6, 9)
- MLR3: Clarify, Critique, Correct (Lesson 4)
- MLR4: Information Gap (Lesson 14)
- MLR5: Co-Craft Questions (Lesson 10)
- MLR6: Three Reads (Lesson 1)
- MLR7: Compare and Connect (Lessons 1, 4, 16)
- MLR8: Discussion Supports (Lessons 5, 6, 11, 12, 13, 15, 16)

Sentence Frames and Stems

Section A

- The expression _____ is equivalent to _____ because ...
- Using the rule for _____ powers, I know that _____ is equal to _____.
- The rule for _____ powers makes sense because ...

Section B

- The expression _____ is equivalent to _____ because ...
- Using the rule for _____ powers, I know that _____ is equal to _____.
- To simplify the expression with powers _____, first I _____, then I ...

Section C

- Using scientific notation, the value _____ can be represented as _____.
- It's helpful to be able to write values like _____ as _____ using scientific notation because ...
- Using a number line to plot the value _____ given in scientific notation, I must first _____, then I ...
- I used the expression _____ to represent this scenario and found the value of _____ to be _____.

Section D

- I know the value _____ is/is not written in scientific notation because ...
- I used the expression _____ to represent this scenario and found the value of _____ to be _____.

Section E

- I know _____ can store _____ times as much as Apollo because ...
- The _____ processor is _____ times as fast as the Apollo.
- _____ has _____ times the memory of the Apollo.

Unit Outline

In this unit, students deepen their understanding of exponents, powers of 10, and place value before being introduced to scientific notation. They build on work done in a previous course where students focused on whole-number exponents with whole-number, fraction, decimal, or variable bases, but did not formulate rules regarding the use of exponents.

$a^n \cdot a^m = a^{n+m}$	$(a^n)^m = a^{n \cdot m}$
$\frac{a^n}{a^m} = a^{n-m}$	$a^0 = 1$
$a^{-n} = \frac{1}{a^n}$	$a^n \cdot a^m = (a \cdot b)^n$

Students begin this unit by identifying patterns that emerge when multiplying and dividing powers of 10, and when raising powers of 10 to another power. Students generalize these patterns to develop exponent rules. They extend these rules to see why 10^0 must be equal to 1 and to understand what negative exponents mean.

Next, students determine that the rules developed for powers of 10 also work with other bases, as long as the bases in both expressions are the same. They observe a new rule that applies when multiplying bases that are different if the exponents are the same.

In the next section, students return to working with powers of 10 as they use multiples of powers of 10 to describe magnitudes of very large and very small quantities, such as the distance from Earth to the sun in kilometers or the mass of a proton in grams. Students plot these large and small values on number lines labeled using exponents and see how these numbers can be expressed in different ways — for example as $75 \cdot 10^5$ or $7.5 \cdot 10^6$.

After building a foundation connecting powers of 10 with place value, students are finally introduced to scientific notation as a specific and useful way of writing numbers as a power of 10. They compute sums, differences, products, and quotients of numbers written in scientific notation to make additive and multiplicative comparisons, estimate quantities, and make measurement conversions.

Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
<p>Section A Exponent Rules (Lessons 1-5)</p>	<p>Learning Target #1 Use exponent rules to generate equivalent numerical expressions for powers of 10.</p>	<p>Lesson 1 Exponent Review</p> <ul style="list-style-type: none"> I can use exponents to describe repeated multiplication. I understand the meaning of a term with an exponent. <p>Lesson 2 Multiplying Powers of 10</p> <ul style="list-style-type: none"> I can explain and use a rule for multiplying powers of 10. <p>Lesson 3 Powers of Powers of 10</p> <ul style="list-style-type: none"> I can explain and use a rule for raising a power of 10 to a power. <p>Lesson 4 Dividing Powers of 10</p> <ul style="list-style-type: none"> I can evaluate 100 and explain why it makes sense. I can explain and use a rule for dividing powers of 10. <p>Lesson 5 Negative Exponents with Powers of 10</p> <ul style="list-style-type: none"> I can use the exponent rules with negative exponents. I know what it means if 10 is raised to a negative power.
<p>Checkpoint A</p>	<p><i>Responding to Student Thinking</i> More Chances: Students will have more opportunities to develop this understanding in later lessons. There is need to slow down or add additional work to review this concept at this time.</p>	
<p>Section B More Exponents Rules (Lessons 6-8)</p>	<p>Learning Target #2 Use exponent rules to generate equivalent numerical expressions for expressions with different bases and bases other than 10.</p>	<p>Lesson 6 What About Other Bases</p> <ul style="list-style-type: none"> I can use the exponent rules for bases other than 10. <p>Lesson 7 Practice with Rational Bases</p> <ul style="list-style-type: none"> I can change an expression with a negative exponent into an equivalent expression with a positive exponent. I can choose an appropriate exponent rule to rewrite an expression to have a single exponent. <p>Lesson 8 Combining Bases</p> <ul style="list-style-type: none"> I can use and explain a rule for multiplying terms that have different bases but the same exponent.
<p>Checkpoint B</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Points to Emphasize: If most students struggle with identifying equivalent exponential expressions, revisit the exponent rules in this practice problem: Problem 2: Points to Emphasize: If most students struggle with multiplying expressions with different bases, revisit this concept in this practice problem: Grade 8, Unit 7, Lesson 10, Practice Problem 6 Problem 3: Points to Emphasize: If most students struggle with explaining why expressions with different bases can not be multiplied if they do not have the same exponent, revisit this concept in this practice problem: Grade 8, Unit 7, Lesson 14, Practice Problem 5 	
<p>Section C Large and Small Numbers</p>	<p>Learning Target #3 Compare very large or very small quantities expressed as a multiple of a power of 10.</p> <p>Learning Target #4 Use exponent rules and powers of 10 to solve problems in context.</p>	<p>Lesson 9 Describing Large and Small Numbers Using Powers of 10</p> <ul style="list-style-type: none"> Given a very large or very small number, I can write an expression equal to it using a power of 10. <p>Lesson 10 Representing Large Numbers on the Number Line</p> <ul style="list-style-type: none"> I can plot a multiple of a power of 10 on such a number line. I can subdivide and label a number line between 0 and a power of 10 with a positive exponent into 10 equal intervals. I can write a large number as a multiple of a power of 10. <p>Lesson 11 Representing Small Numbers on the Number Line</p> <ul style="list-style-type: none"> I can plot a multiple of a power of 10 on such a number line. I can subdivide and label a number line between 0 and a power of 10 with a negative exponent into 10 equal intervals.

		<ul style="list-style-type: none"> I can write a small number as a multiple of a power of 10. <p>Lesson 12 Applications of Arithmetic with Powers of 10</p> <ul style="list-style-type: none"> I can apply what I learned about powers of 10 to answer questions about real-world situations.
Checkpoint C	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: More Chances: Students will have more opportunities to develop this understanding in later lessons. There is no need to slow down or add additional work to review this concept at this time. Problem 2: More Chances 	
<p>Section D Scientific Notation (Lessons 13-15)</p>	<p>Learning Target #5 Calculate with numbers in scientific notation and interpret them in context..</p> <p>Learning Target #10 Identify numbers written in scientific notation, including scientific notation that has been generated by technology.</p>	<p>Lesson 13 Definition of Scientific Notation</p> <ul style="list-style-type: none"> I can tell whether or not a number is written in scientific notation. <p>Lesson 14 Estimating with Scientific Notation</p> <ul style="list-style-type: none"> I can multiply and divide numbers given in scientific notation. I can use scientific notation and estimation to compare very large very small numbers. <p>Lesson 15 Adding and Subtracting with Scientific Notation</p> <ul style="list-style-type: none"> I can add and subtract numbers given in scientific notation.
Checkpoint D	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Press Pause: If most students struggle with identifying numbers written in scientific notation make time to revisit related work in the lesson referred to here. See the Course Guide for ideas to help students re-engage with earlier work Grade 8, Unit 7, Lesson 13 Definition of Scientific Notation Problem 2: Press Pause: If most students struggle with arithmetic with numbers written in scientific notation, make time to revisit related work in the lesson referred to here. See the Course Guide for ideas to help students re-engage with earlier work. Grade 8, Unit 7, Lesson 15 Adding and Subtracting with Scientific Notation 	
<p>Section E Let's Put it to Work (Lessons 16)</p>	<p>Learning Target #11 Use scientific notation to compare quantities in context, and describe (orally) how using scientific notation helps with making comparisons between very large and very small quantities.</p>	<p>Lesson 16 Is a Smartphone Enough to Go to the Moon?</p> <ul style="list-style-type: none"> I can use scientific notation to compare different amounts and answer questions about real-world situations
End of Unit Assessment		

Unit Title:**Unit 6: Introduction to Exponential Functions (iM U6)****Relevant Standards: Bold indicates priority**

Lesson	Standards	Lesson	Standards
Lesson 1	HSF-IF.B.4, HSF-LE.A.3	Lesson 13	HSF-IF.B.6
Lesson 2	HSF-BF.A.1.a, HSF-IF.B.4, HSF-IF.C.9	Lesson 14	HSF-BF.A.1, HSF-IF.A.2, HSF-IF.B.4, HSF-IF.B.5, HSF-LE.A.1, HSF-LE.A.1.c, HSF-LE.A.2, HSF-LE.B.5, HSN-Q.A.1, HSN-Q.A.3, HSS-ID.B.6.a
Lesson 3	HSA-CED.A.2, HSF-BF.A.1.a, HSF-LE.B.5	Lesson 15	HSF-IF.B.4, HSF-IF.C.9, HSF-LE.B.5
Lesson 4	HSA-CED.A.2, HSF-IF.B.4, HSF-LE.B.5	Lesson 16	HSF-IF.B.4, HSF-LE.A.2, HSF-LE.B.5
Lesson 5	HSA-CED.A.2, HSA-SSE.A.1, HSF-BF.A.1.a, HSF-LE.B.5	Lesson 17	None listed
Lesson 6	HSA-CED.A.2, HSF-IF.B.4, HSF-IF.C.9	Lesson 18	HSF-BF.A.1, HSF-BF.A.1.a, HSF-IF.B.6, HSF-IF.C.7.e, HSF-LE.A.2
Lesson 7	HSA-CED.A.2, HSA-SSE.A.1, HSN-Q.A.1	Lesson 19	HSF-BF.A.1.a
Lesson 8	HSN-RN.A	Lesson 20	HSA-SSE.A, HSA-SSE.A.1, HSF-BF.A.1.a, HSF-IF.A.2, HSN-Q.A.2
Lesson 9	HSN-RN.A	Lesson 21	HSA-SSE.A.1.b, HSA-SSE.B.3.c, HSF-IF.A.2, HSF-IF.C.8, HSF-IF.C.8.b
Lesson 10	HSN-RN.A	Lesson 22	HSF-IF.A.2, HSF-IF.B.4, HSF-IF.B.5, HSF-LE.A. HSF-LE.A.2, HSF-LE.A.3
Lesson 11	HSF-IF.A.2, HSF-IF.B, HSF-IF.B.5, HSF-IF.C.7, HSF-LE.A.2, HSN-Q.A.1	Lesson 23	HSF-LE.A.1.a, HSF-LE.A.1.b, HSF-LE.A.2
Lesson 12	HSA-SSE.A, HSF-IF.A.2, HSF-IF.B.5, HSF-IF.C.7.e, HSF-LE.A.2	Lesson 24	HSF-LE.A.1, HSF-LE.A.1.b, HSF-LE.A.1.c, HSF-LE.A.2, HSN-Q.A.3, HSS-ID.B.6.a

Essential Question(s):

- 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?

Enduring Understanding(s):

- 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.

Demonstration of Learning:

Checkpoint A (after Lesson 2): Opportunity for Feedback
 Checkpoint B (after Lesson 6): Opportunity for Feedback
 CFA 1: Checkpoint C (after Lesson 10)
 Checkpoint D (after Lesson 16): Opportunity for Feedback
 Mid-Unit Assessment (after Lesson 16)
 CFA 2: Checkpoint Section E (after Lesson 21)
 Checkpoint F (after Lesson 23): Opportunity for Feedback
 Checkpoint G (after Lesson 24): Opportunity for Feedback
 End-of-Unit Assessment (after Lesson 24)

Pacing for Unit**25 Days**

Lessons to Review/Add:

- 8.7 Lessons 2–4: Emphasize Lesson 2 Activity 2, Lesson 3 Activity 1, and Lesson 4 Activity 1. Students can complete practice problems or other activities outside of class. Note that Algebra 1 Lesson 3 provides additional opportunities to review these concepts.
- 8.7 Lessons 5–6: Emphasize the meaning of negative exponents, and the idea that exponent laws for 10 apply to all numbers. Assign practice problems for outside of class work.

Lesson Modifications:

	<ul style="list-style-type: none"> • Lessons 8, 9, 10, 16, 17 are optional • Omit Lesson 20. This lesson explores how exponential functions grow over equal intervals. It is not essential for the successful completion of this course and will be addressed in more detail in Algebra 2. • Omit Lesson 21. In this lesson students apply their learning from the unit to model different populations with linear and exponential functions. While it provides an opportunity to consolidate learning from the unit, it does not introduce new topics. 																																							
Family Overview	Integration of Technology:																																							
https://accessim.org/9-12-aga/algebra-1/unit-6?a=family	<ul style="list-style-type: none"> • Desmos Online Graphing Calculator • Pear Assessment (Edulastic) 																																							
Unit-specific Vocabulary:	Aligned Unit Materials, Resources, and Technology																																							
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)	<p>Provide access as needed throughout the unit:</p> <ul style="list-style-type: none"> • A collection of balls that bounce • Blank paper • Graphing technology • Math Community Chart • Measuring tapes • Scientific calculators • Spreadsheet technology • Tools for creating a visual display <table border="1"> <thead> <tr> <th>Lesson</th> <th>Materials to Gather</th> <th>Materials to Copy</th> </tr> </thead> <tbody> <tr> <td>1</td> <td> <ul style="list-style-type: none"> • Scientific calculators: Activity 1 • Spreadsheet technology: Activity 1 </td> <td></td> </tr> <tr> <td>2</td> <td>Spreadsheet technology: Activity 1</td> <td></td> </tr> <tr> <td>6</td> <td></td> <td>Matching Descriptions to Graphs Cards (1 copy for every 2 students): Activity 2</td> </tr> <tr> <td>7</td> <td>Graphing technology: Activity 2</td> <td></td> </tr> <tr> <td>11</td> <td>Graphing technology: Activity 1, Activity 3</td> <td></td> </tr> <tr> <td>12</td> <td> <ul style="list-style-type: none"> • Blank paper: Activity 2 • Graphing technology: Activity 2 </td> <td>Smartphone Sales Cards (1 copy for every 2 students): Activity 2</td> </tr> <tr> <td>4</td> <td> <ul style="list-style-type: none"> • A collection of balls that bounce: Activity 2 • Measuring tapes: Activity 2 </td> <td></td> </tr> <tr> <td>15</td> <td>Graphing technology: Activity 1, Activity 2</td> <td></td> </tr> <tr> <td>16</td> <td>Graphing technology: Activity 1, Activity 2</td> <td></td> </tr> <tr> <td>18</td> <td>Graphing technology: Activity 2</td> <td></td> </tr> <tr> <td>20</td> <td>Math Community Chart: Activity 1</td> <td></td> </tr> <tr> <td>22</td> <td>Graphing technology: Activity 1, Activity 2</td> <td></td> </tr> </tbody> </table>	Lesson	Materials to Gather	Materials to Copy	1	<ul style="list-style-type: none"> • Scientific calculators: Activity 1 • Spreadsheet technology: Activity 1 		2	Spreadsheet technology: Activity 1		6		Matching Descriptions to Graphs Cards (1 copy for every 2 students): Activity 2	7	Graphing technology: Activity 2		11	Graphing technology: Activity 1, Activity 3		12	<ul style="list-style-type: none"> • Blank paper: Activity 2 • Graphing technology: Activity 2 	Smartphone Sales Cards (1 copy for every 2 students): Activity 2	4	<ul style="list-style-type: none"> • A collection of balls that bounce: Activity 2 • Measuring tapes: Activity 2 		15	Graphing technology: Activity 1, Activity 2		16	Graphing technology: Activity 1, Activity 2		18	Graphing technology: Activity 2		20	Math Community Chart: Activity 1		22	Graphing technology: Activity 1, Activity 2	
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Opportunities for Interdisciplinary Connections:	Anticipated misconceptions:																																							
Science	<ul style="list-style-type: none"> • Many students interpret the exponent as multiplication 																																							

<ul style="list-style-type: none"> • 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. <p>Social Studies</p> <ul style="list-style-type: none"> • Exponential functions model financial growth, such as compound interest, and demographic trends, such as population growth or decline. <p>Health & Physical Education</p> <ul style="list-style-type: none"> • 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. <p>Personal Finance</p> <ul style="list-style-type: none"> • Many activities refer to investments and debt, both of which grow exponentially. 	<ul style="list-style-type: none"> • 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 $\frac{1}{5}$ or $\frac{1}{5}$. <p>See teacher's guide for specific misconceptions aligned to each lesson.</p>
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Connections to Prior Units:	Connections to Future Units:
<p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> • Percent change • Exponents <p>Relevant Unit(s)/Lesson(s) to Review:</p> <ul style="list-style-type: none"> • Grade 8 Unit 7: Exponents and Scientific Notation • Grade 7 Unit 4: Proportional Relationships and Percentages 	<p>Connection to Unit 6: Quadratic Functions</p> <ul style="list-style-type: none"> • 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

Differentiation through [Universal Design for Learning](#)

<p>Engagement:</p> <ul style="list-style-type: none"> • Chunk tasks by inviting students to choose one specific graph to analyze first (Lesson 7, Activity 2 Launch) <p>Representation:</p> <ul style="list-style-type: none"> • Provide a timeline to connect positive and negative exponents to specific years (Lesson 7, Activity 1 Launch) <p>Action & Expression:</p> <ul style="list-style-type: none"> • Provide tools like a blank table or graphing software to calculate total balances (Lesson 20, Activity 2 Launch)

Supporting Multilingual Learners

<p>Math Language Routines</p> <p>The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners:</p> <p>MLR1: <i>Stronger and Clearer Each Time</i> - Students revise and refine their mathematical language through multiple drafts</p> <p>MLR2: <i>Collect and Display</i> - Students capture and organize language in visual displays</p> <p>MLR3: <i>Clarify, Critique, Correct</i> - Students analyze mathematical writing/talk</p> <p>MLR4: <i>Information Gap</i> - Students share information to solve problems</p> <p>MLR5: <i>Co-Craft Questions</i> - Students create and improve questions</p> <p>MLR6: <i>Three Reads</i> - Students analyze complex mathematical text</p> <p>MLR7: <i>Compare and Connect</i> - Students connect different mathematical representations</p> <p>MLR8: <i>Discussion Supports</i> - Students participate in mathematical discussions</p> <p>In this unit:</p> <ul style="list-style-type: none"> • MLR1: Stronger and Clearer Each Time (Lessons 1, 7, 10, 20) • MLR2: Collect and Display (Lessons 3, 5, 6, 11, 15, 21) • MLR3: Clarify, Critique, Correct (Lesson 23)
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- MLR4: Information Gap (Lesson 14)
- MLR5: Co-Craft Questions (Lessons 14, 16, 20)
- MLR6: Three Reads (Lessons 1, 18, 22)
- MLR7: Compare and Connect (Lessons 22, 24)
- MLR8: Discussion Supports (Lessons 2, 3, 4, 6, 11, 15, 17, 21)

Sentence Frames and Stems

Section A

- I used the _____ (representation/tool) to determine this is a/an _____ relationship.
- In the _____ function, the constant difference/factor is _____ because ...
- The equation _____ represents this situation because ...
- The _____ is _____ by _____ each _____, so the relationship is _____.

Section B

- The equation _____ represents this situation because ...
- I can connect the equation to the graph by ...
- In this situation, there is a starting value of _____ with a growth factor of _____.
- On the graph of the exponential equation _____, the a value is _____ and can be found _____. The b value is _____ and can be found _____.
- This situation represents exponential growth/decay because the growth factor is _____ which means ...

Section C

- In this situation, the exponent _____ in the equation _____ means ...
- The value of the exponential expression _____ when the exponent is _____ is _____.
- The simplified value of the algebraic expression is _____ because ...

Section D

- The function _____ represents this situation because ...
- The graph of the situation should be discrete/continuous because ...
- For the function _____, the value of the output is _____ when the input is _____.

Section E

- The function _____ represents a _____ percent increase applied _____ times.
- The amount of _____ after _____ year(s) will be _____ because ...
- Since the interest is compounded _____ (time interval) at _____ percent, we can _____ to find _____.

Section F

- For the function _____, the rate of change from _____ to _____ is _____.
- The function _____ is _____ because ...

Unit Outline

In this unit, students build on their understanding of linear functions, properties of exponents, and percent change to explore exponential relationships. Students learn that exponential relationships are characterized by a constant quotient over equal intervals, and compare it to linear relationships, which are characterized by a constant difference over equal intervals. They encounter contexts that change exponentially. These contexts are presented verbally and with tables and graphs. They construct equations and use them to model situations and solve problems. At first, students investigate these exponential relationships without using function notation and language so that they can focus on gaining an appreciation for critical properties and characteristics of exponential relationships.

Later, students view these relationships as functions and employ the notation and terminology of functions. They study graphs of exponential functions both in terms of contexts that they represent and abstract functions that don't represent a particular context, observing the effect of different values of a and b on the graph of the function f represented by $f(x)=ab^x$.



The contexts used early in this unit lead to functions where the domain is the integers. In some situations, students will interpret exponential expressions with fractional values in the exponent using graphing, but the connection to roots or logarithms is left for a later course.

Note on materials: Throughout this unit, students should have access to a calculator with an exponent button. Access to graphing technology is necessary for some activities and encouraged throughout the unit. Examples of graphing technology include a handheld graphing calculator, a computer with a graphing calculator application installed, or an internet-enabled device with access to a site like [desmos.com/calculator](https://www.desmos.com/calculator) or [geogebra.org/graphing](https://www.geogebra.org/graphing). Interactive applets are embedded throughout, and a graphing calculator tool is accessible in the Math Tools in the digital version.

Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
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<p>Section A Looking at Growth Lessons 1-2</p>	<p>Learning Target #1 Compare linear and exponential relationships by performing calculations.</p> <p>Learning Target #2 Describe patterns in tables that represent linear and exponential relationships.</p>	<p>Lesson 1 Growing and Growing</p> <ul style="list-style-type: none"> I can compare growth patterns using calculations and graphs. <p>Lesson 2 Patterns of Growth</p> <ul style="list-style-type: none"> 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. <p>Checkpoint A problem 1 Checkpoint A problem 2</p>
<p>Checkpoint A</p>	<p><i>Responding to Student Thinking</i> Points to Emphasize: If students struggle to determine the growth patterns, revisit the idea throughout the unit. For example, in the optional activity referred to here, ask students to describe the pattern and then to determine whether it changes by a factor or a difference.</p>	
<p>Section B A New Kind of Relationship Lessons 3-6</p>	<p>Learning Target #3 Write and graph an equation that represents exponential decay to solve problems.</p> <p>Learning Target #4 Write an equation of the form $y = a \cdot b^x$ to represent a quantity a that changes by a growth factor b.</p>	<p>Lesson 3 Representing Exponential Growth</p> <ul style="list-style-type: none"> 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. <p>Middle of Unit problem 1 <i>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.</i> Middle of Unit Problem 4 End of Unit Problem 1</p> <ul style="list-style-type: none"> I can graph equations that represent quantities that change by a growth factor that is greater than 1. <p>Middle of Unit Problem 6</p> <p>Lesson 4 Representing Exponential Decay</p> <ul style="list-style-type: none"> I can explain the meanings of a and b in an equation that represents exponential decay and is written as $y = a \cdot b^x$. 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. <p>Checkpoint B Problem 1 Checkpoint B problem 3</p> <p>Lesson 5 Understanding Decay</p> <ul style="list-style-type: none"> 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. I can interpret an equation that represents exponential decay. I know the meanings of "exponential growth" and "exponential decay." <p>Checkpoint B Problem 1 Middle of Unit Problem 7</p> <p>Lesson 6 Analyzing Graphs</p> <ul style="list-style-type: none"> 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.
<p>Checkpoint B</p>	<p><i>Responding to Student Thinking</i> More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time.</p>	

<p>Section C Negative and Fractional Exponents Lessons 7-10</p>	<p>Learning Target #5 Interpret a negative exponent in equations that represent exponential growth or decay.</p> <p>Learning Target #6 Use roots and fractional exponents to represent the same value in different ways.</p>	<p>Lesson 7 Using Negative Exponents</p> <ul style="list-style-type: none"> 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 <p>Lesson 8 Exponential Rules (Optional)</p> <ul style="list-style-type: none"> I can use the idea that $\sqrt[n]{a}^n = a$ to compute values. I can write exponent rules for $a^b \cdot a^c, \frac{a^b}{a^c}, (a^b)^c$ <p>Lesson 9 Unit Fractional Exponents (Optional)</p> <ul style="list-style-type: none"> I can rewrite roots in a form with a fractional exponent. <p>Lesson 10 Other Fractional Exponents (Optional)</p> <ul style="list-style-type: none"> I can rewrite roots raised to a power as values with a fractional exponent.
<p>Checkpoint C</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Points to Emphasize: If students struggle to interpret a negative exponent in a situation, emphasize the concept throughout the unit. For example, in the activity referred to here, emphasize what an input of -1 could mean or what the model predicts for the year 1976. Problem 2: Press Pause: If students struggle to use fractional exponents and roots to write expressions that have the same value, make time to revisit the idea. For example, use the practice problems referred to here to provide additional practice. Algebra 1, Unit 6, Lesson 10, Practice Problem 4 Algebra 1, Unit 6, Lesson 10, Practice Problem 2 	
<p>Mid-Unit Assessment</p>		
<p>Section D Exponential Functions Lessons 11-16</p>	<p>Learning Target #7 Describe the effect of changing a and b on a graph that represents $y = a \cdot b^x$.</p> <p>Learning Target #8 Use function notation to write equations that represent exponential relationships.</p>	<p>Lesson 11 Exponential Situations as Functions</p> <ul style="list-style-type: none"> 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, graphs, I can determine whether the relationships are functions. Checkpoint C Problem 1.1 <p>Lesson 12 Interpreting Exponential Functions</p> <ul style="list-style-type: none"> 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 <p>Lesson 13 Looking at Rates of Change</p> <ul style="list-style-type: none"> 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. <p>Lesson 14 Modeling Exponential Behavior</p> <ul style="list-style-type: none"> 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 <p>Lesson 15 Reasoning about Exponential Graphs (Part 1)</p>

		<ul style="list-style-type: none"> I can describe the effect of changing a and b on a graph that represents $f(x) = a \cdot b^x$. <div style="border: 1px solid red; padding: 2px;"> <p>Checkpoint C Problem 2 Middle of Unit Problem 2</p> </div> <ul style="list-style-type: none"> I can use equations and graphs to compare exponential functions. <p>Lesson 16 Reasoning about Exponential Graphs (Part 2) (Optional)</p> <ul style="list-style-type: none"> I can explain the meaning of the intersection of the graphs of two functions in terms of the situations they represent. When I know two points on a graph of an exponential function, I can write an equation for the function. <div style="border: 1px solid red; padding: 2px;"> <p>End of Unit Problem 6 <i>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 2³ times larger after x increases by 3, it should be worded that way.</i></p> </div>
<p>Checkpoint D</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time. Problem 2: Points to Emphasize: If students struggle to match the graphs to the exponential functions, revisit the idea throughout the next sections. For example, after completing the activity referred to here, ask students to look back on this Checkpoint question to interpret the functions in terms of percentage to make a connection to the amount of growth happening in each graph. Algebra 1, Unit 6, Lesson 18, Activity 2 Comparing Loans 	
<p>Section E Percent Growth and Decay Lessons 17-21</p>	<p>Learning Target #9 Calculate the result of repeated percent increase for the same initial balance and interest rate, but compounded at different intervals.</p> <p>Learning Target #10 I can justify why applying a percent increase p, n times, is not equivalent to applying the percent np.</p>	<p>Lesson 17 Recalling Percent Change (Optional)</p> <ul style="list-style-type: none"> 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. <div style="border: 1px solid red; padding: 2px;"> <p>Checkpoint D Problem 1 End of Unit Problem 3</p> </div> <p>Lesson 18 Functions Involving Percent Change</p> <ul style="list-style-type: none"> 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. <div style="border: 1px solid red; padding: 2px;"> <p>End of Unit Problem 5</p> </div> <p>Lesson 19 Compounding Interest</p> <ul style="list-style-type: none"> I can explain why applying a percent increase, p, n times is or unlike applying the percent increase np. <div style="border: 1px solid red; padding: 2px;"> <p>Checkpoint D Problem 1</p> </div> <p>Lesson 20 Different Compounding Intervals</p> <ul style="list-style-type: none"> I can calculate interest when I know the starting balance, interest rate, and compounding intervals. <div style="border: 1px solid red; padding: 2px;"> <p>End of Unit problem 2 End of Unit problem 4</p> </div> <ul style="list-style-type: none"> When given interest rates and compounding intervals, I can choose the better investment option. <div style="border: 1px solid red; padding: 2px;"> <p>Checkpoint D Problem 2</p> </div> <p>Lesson 21 Expressed in Different Ways</p> <ul style="list-style-type: none"> I can solve problems using exponential expressions written in different ways. <div style="border: 1px solid red; padding: 2px;"> <p>End of Unit Problem 2</p> </div> <ul style="list-style-type: none"> I can write equivalent expressions to represent situations that involve repeated percent increase or decrease.

		End of Unit Problem 3
Checkpoint E	<i>Responding to Student Thinking</i> <ul style="list-style-type: none"> • Problem 1: Press Pause If students struggle to show that the ratio between $f(x+1)$ and $f(x)$ is a constant, make time to revisit the idea. For example, use the lesson referred to here to connect growth factors to this idea. In the activity referred to here, note the connection between the term "doubling" and the exponential form of the function. Algebra 1, Unit 6, Lesson 2 Patterns of Growth Algebra 1, Unit 6, Lesson 3, Activity 3 Multiplying Microbes • Problem 2: Press Pause If students struggle to show their understanding that exponential growth is eventually faster than linear growth, make time to revisit the idea. For example, use the activities referred to here to examine graphs of linear and exponential functions to show that exponential functions are eventually greater than linear functions. Algebra 1, Unit 6, Lesson 2, Activity 2 Growing Stores Algebra 1, Unit 6, Lesson 19, Activity 3 Reaching 2,000 	
Section F Comparing Linear and Exponential Functions Lesson 22-23	Learning Target #11 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. Learning Target #12 Use tables, calculations, and graphs to compare growth rates of linear and exponential functions.	Lesson 22 Which One Changes Faster? <ul style="list-style-type: none"> • 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 23 Changes over Equal Intervals <ul style="list-style-type: none"> • 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
Checkpoint F	<i>Responding to Student Thinking</i> <ul style="list-style-type: none"> • Problem 1: Press Pause If students struggle to show that the ratio between $f(x+1)$ and $f(x)$ is a constant, make time to revisit the idea. For example, use the lesson referred to here to connect growth factors to this idea. In the activity referred to here, note the connection between the term "doubling" and the exponential form of the function. Algebra 1, Unit 6, Lesson 2 Patterns of Growth Algebra 1, Unit 6, Lesson 3, Activity 3 Multiplying Microbes • Problem 2: Press Pause If students struggle to show their understanding that exponential growth is eventually faster than linear growth, make time to revisit the idea. For example, use the activities referred to here to examine graphs of linear and exponential functions to show that exponential functions are eventually greater than linear functions. Algebra 1, Unit 6, Lesson 2, Activity 2 Growing Stores Algebra 1, Unit 6, Lesson 19, Activity 3 Reaching 2,000 	
Section G Let's Put It to Work Lesson 24	No new learning targets	Lesson 24 Predicting Populations <ul style="list-style-type: none"> • 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.
End of Unit Assessment		

Unit Title:			
Unit 7: Topics in Grade 8 (BPS)			
Relevant Standards: Bold indicates priority			
Lesson	Standards	Lesson	Standards
U5 Lesson 13/14	8.G.C.9, 8.G.C	U8 Lesson 3	8.EE.A.2, 8.NS.A, 8.NS.A.1, 8.NS.A.2
U5 Lesson 15/16	8.G.C.9, 8.G.C	U8 Lesson 4	8.EE.A.2, 8.NS.A, 8.NS.A.1, 8.NS.A.2
U5 Lesson 20	8.G.C.9, 8.G.C	U8 Lesson 6	8.EE.A.2, 8.NS.A, 8.NS.A.1, 8.NS.A.2
U5 Lesson 21	8.G.C.9, 8.G.C	U8 Lesson 9	8.G.B.7
		U8 Lesson 10	8.G.B.7
		U8 Lesson 11	8.G.B.7
		U8 Lesson 13	8.G.B.8
		U8 Lesson 15	8.EE.A.2, 8.NS.A.2
Essential Question(s):		Enduring Understanding(s):	
<ul style="list-style-type: none"> How do we measure what we cannot see directly? Why do some numbers resist being written as simple fractions? How do we represent and solve equations we cannot solve with whole numbers or fractions alone? How is the Pythagorean Theorem a bridge between algebra, geometry, and proof? How do we find what we're looking for when direct measurement isn't possible? 		<ul style="list-style-type: none"> Equations like $x^2=n$ require us to extend beyond rational numbers and use radical notation. Square roots and cube roots provide notation and meaning for solutions that often fall between integers. Representing these solutions on the number line connects symbolic notation to geometric understanding. The Pythagorean Theorem is both a geometric relationship and an algebraic tool. Understanding the area-based proof reveals why the relationship $a^2 + b^2= c^2$ works and connects areas to squares of side lengths. This theorem enables us to find unknown distances, verify right angles, and solve real-world problems—demonstrating how abstract mathematical relationships have concrete applications. Mathematical tools—formulas, theorems, and reasoning—allow us to determine distances and dimensions that we cannot physically measure. The coordinate plane, the Pythagorean Theorem, and radical notation work together to solve problems in abstract and real-world contexts. This reflects the power of mathematics to extend beyond what we can directly observe. 	
Demonstration of Learning:		Pacing for Unit	
CFA 1: Checkpoint D & E (after G8 U5 Lesson 21) CFA 2: Checkpoint A (after G8 U8 Lesson 6) CFA 3: Checkpoint B #1 & 2 only (after G8 U8 Lesson 15) EOU Assessment		16 Days Lesson Modifications: G8 Unit 5 Section D & E <ul style="list-style-type: none"> Start with Lesson 13/14 Combine Lesson 15/16 Skip Lessons 17-19 Checkpoint D and E together on the same day G8 Unit 8 Section A, B & C <ul style="list-style-type: none"> Skip Lessons 1-2, 5, 7, 8, 12, 14 	
Family Overview		Integration of Technology:	
https://accessim.org/6-8/grade-8/unit-5?a=family https://accessim.org/6-8/grade-8/unit-8?a=family		<ul style="list-style-type: none"> Desmos Online Graphing Calculator Pear Assessment (Edulastic) iM v.360 Digital Applets (see below) 	
Unit-specific Vocabulary:		Aligned Unit Materials, Resources, and Technology	
Radius, volume, cylinder, cone, sphere, square root, rational number, irrational number, hypotenuse, Legs, Pythagorean Theorem, cube root, repeating decimal		Digital Applets <ul style="list-style-type: none"> 8.5.11 Digital Applet: Height and Volume 8.8.1 Digital Applet: Making Squares 8.8.2 Digital Applet: The Sides and Areas of Tilted Squares 	

- 8.8.8 Digital Applet: A Transformational Proof

Provide access as needed throughout the unit:

- Colored pencils
- Graduated cylinders
- Math Community Chart
- Spherical objects
- Straightedges
- Tools for creating a visual display

Lesson	Materials to Gather	Materials to Copy
UNIT 5		
11	Graduated cylinders: Activity 1	
13	Colored pencils: Activity 2	
19	Spherical objects: Activity 2	
21	Tools for creating a visual display: Lesson Math Community Chart: Activity 2	Unknown Dimensions Cards (1 copy for every 4 students): Activity 2
UNIT 8		
1		Making Squares Cutouts (1 copy for every 2 students): Activity 2
2	<ul style="list-style-type: none"> • Geometry toolkits: Activity 1, Activity 2 • Tracing paper: Activity 1, Activity 2 	
3	<ul style="list-style-type: none"> • Geometry toolkits: Activity 1, Activity 3 • Tracing paper: Activity 1 • Four-function calculators: Activity 2 	
4	<ul style="list-style-type: none"> • Geometry toolkits: Activity 2 • Tracing paper: Activity 2 • Four-function calculators: Activity 4 	
5	<ul style="list-style-type: none"> • Compasses: Activity 2 • Geometry toolkits: Activity 2 • Four-function calculators: Activity 3 	
8	<ul style="list-style-type: none"> • Blank paper: Lesson • Scissors: Activity 3 	A Transformational Proof Cutouts (1 copy for every 2 students): Activity 3
9	Blank paper: Lesson	
12	Math Community Chart: Activity 2	Pythagorean Theorem Cards (1 copy for every 2 students): Activity 2
14	Math Community Chart: Activity 3	Rooted in the Number Line Cards (1 copy for every 2 students): Activity 3

	17	Some Numbers Are Rational Cards (1 copy for every 2 students): Activity 2
	18	Scientific calculators: Activity 2, Activity 3
Opportunities for Interdisciplinary Connections:		
<p>Earth Science</p> <ul style="list-style-type: none"> Model atmospheric pressure using sphere volume; explore planetary volumes to compare sizes <p>Astronomy</p> <ul style="list-style-type: none"> Calculate distances between stars or planets using coordinates; explore the concept of irrational numbers in orbital mechanics <p>Sports</p> <ul style="list-style-type: none"> Calculate distances in sports (baseball diamond, soccer field diagonals, skateboarding ramps) <p>Music:</p> <ul style="list-style-type: none"> Irrational numbers appear in frequency ratios and musical intervals Understand how irrational numbers relate to string lengths and acoustic resonance <p>Art & Design:</p> <ul style="list-style-type: none"> Golden Ratio — Connect irrational numbers (phi) to aesthetics and composition in visual art Architecture — Explore how irrational numbers appear in building design and proportions Sculpture — Design cylindrical, conical, and spherical forms; understand volume relationships in 3D art 	<p>Anticipated misconceptions:</p> <p>Solving for Unknown Dimensions</p> <ul style="list-style-type: none"> When solving volume equations for a missing dimension, students may not isolate the variable correctly Trouble handling the $\frac{1}{3}$ in cone equations — forgetting to multiply by 3 when solving <p>Context & Real-World Applications</p> <ul style="list-style-type: none"> Looking at pictures that aren't to scale and assuming they represent the actual volumes Not considering that changing dimensions affects how much something holds In the popcorn container problem: overestimating cone volume because it "looks bigger" visually <p>Understanding Square Roots:</p> <ul style="list-style-type: none"> Not recognizing that $\sqrt{9}=3$, not $9 \div 2$ <p>Perfect Squares</p> <ul style="list-style-type: none"> Not memorizing/recognizing perfect squares: 1,4,9,16,25,36,49,64,81,100,121,144 Thinking $\sqrt{2}$ is a whole number <p>Irrational Numbers</p> <ul style="list-style-type: none"> Thinking all irrational numbers are square roots (forgetting π) Believing irrational numbers are "made up" or not real Confusing irrational with non-integer (integers and fractions are rational) Not understanding that irrational numbers can't be written as a ratio of two integers Thinking $\sqrt{2}=1.1421356\dots$ has a pattern or repeats Assuming all non-terminating decimals are irrational <p>Pythagorean Theorem</p> <ul style="list-style-type: none"> Thinking the Pythagorean Theorem applies to all triangles (only right triangles) Not identifying which side is the hypotenuse in a right triangle Confusing legs and hypotenuse: thinking the shortest side is always the hypotenuse Not understanding you need to solve backwards when finding a leg <p>See teacher's guide for specific misconceptions aligned to each lesson.</p>	
Connections to Prior Units:		
<p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> Volume of a rectangular prism Exponents Area of a circle (radius vs diameter) Solving Equations Right angle <p>Relevant Unit(s)/Lesson(s) to Review:</p> <ul style="list-style-type: none"> Grade 6 Unit 6 Expressions and Equations Grade 7 Unit 3 Measuring Circles Grade 7 Unit 7 Angles and Triangles Grade 8 Unit 4 Linear Equations and Linear Systems 	<p>Connections to Future Units:</p> <p>This unit contains content that is necessary for success on the Smarter Balanced Assessment. Volume and the Pythagorean Theorem connect to High School Geometry. Rational and irrational numbers will support the quadratics unit when solving equations and finding x-intercepts.</p>	
<p>Differentiation through <i>Universal Design for Learning</i></p>		

Engagement:

- Chunk task and assess comprehension after every two rows of missing cone dimensions (G8 Unit 5, Lesson 16 Activity 2 Launch)

Representation:

- Use a kinesthetic representation of the number line (e.g., a clothesline) (G8 Unit 8, Lesson 15 Activity 2 Synthesis)

Action & Expression:

- Provide access to digital applets for measuring height and volume (G8 Unit 5, Lesson 11 Activity 1 Launch)

Supporting Multilingual Learners

Math Language Routines

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

In this unit:

- MLR1: Stronger and Clearer Each Time (G8 Unit 5, Lessons 11, 14, 17, 22; G8 Unit 8, Lessons 5, 6, 13)
- MLR2: Collect and Display (G8 Unit 5, Lessons 7, 11; G8 Unit 8, Lesson 7)
- MLR3: Clarify, Critique, Correct (G8 Unit 5, Lesson 15; G8 Unit 8, Lesson 9)
- MLR4: Information Gap (G8 Unit 8, Lessons 12, 21)
- MLR5: Co-Craft Questions (G8 Unit 8, Lesson 8)
- MLR6: Three Reads (G8 Unit 5, Lesson 3; G8 Unit 8, Lessons 11, 18)
- MLR8: Discussion Supports (G8 Unit 5, Lessons 11, 14, 16, 21 G8 Unit 8, Lessons 6, 11, 15)

Sentence Frames and Stems

Section A (Gr 8 Unit 8 Rational/Irrational Numbers)

- _____ is an irrational number because ...
- The square root of _____ must be _____ because ...
- The solution to the equation _____ is _____ because ...
- To place the square root of _____ on a number line, first I _____, then I ...

Section B (Gr 8 Unit 8 Rational/Irrational Numbers)

- The distance between point _____ and point _____ is _____ because ...
- If the leg lengths of the right triangle are _____ and _____, then the hypotenuse must be _____ because ...
- The side lengths _____, _____, and _____ make a right triangle because ...
- I used the equation _____ to find the missing side length of the right triangle. The missing side length is _____.

Section C (Gr 8 Rational/Irrational Numbers)

- If the volume of a cube is _____, the edge length must be _____ because ...
- The cube root of _____ must be _____ because ...
- To place the cube root of _____ on a number line, first I _____, then I ...
- The solution to the equation _____ is _____ because ...

Section D (Gr 8 Unit 5 Volume)

- I know the volume of the cylinder/cone is _____, and the radius of the base is _____, so the height must be _____ because ...
- The volume of the cylinder is _____ because ...
- The volume of the cone is _____ because ...
- As the radius of the base increases by _____, the volume of the cylinder/cone increases by _____ because ...

Section E (Gr 8 Unit 5 Volume)

- When the radius of the _____ is changed by _____, the volume ...
- The volume of the hemisphere is _____ because ...
- The volume of the sphere is _____ because ...

Unit Outline

Unit 5

In the remaining three sections of the unit, students build on their knowledge of the formula for the volume of a right rectangular prism from grade 7, learning formulas for volumes of cylinders, cones, and spheres. Students express functional relationships described by these formulas as equations, focusing on situations involving proportional relationships. They use these relationships to reason about how the volume of a figure changes as one of its dimensions changes, transforming algebraic

expressions to get the information they need. In future courses, students will continue this thinking as they study nonlinear relationships and question how, for example, the volume of a sphere changes as the radius increases.

Unit 8

In the first section, students extend work from grade 6, composing and decomposing shapes to find the areas of tilted squares. They see “square root of n ” and \sqrt{n} to mean the side length of a square with area n square units, and understand that finding the solution to equations of the form $x^2=n$ means determining which values of x make the equation true. Students learn and use definitions for “rational number” and “irrational number,” learn (without proof) that $\sqrt{2}$ is irrational, and plot square roots on the number line.

In the second section, students continue using tilted squares as they investigate relationships between side lengths of right and non-right triangles. Students are encouraged to notice patterns among the triangles before being shown geometric and algebraic proofs of the Pythagorean Theorem. They use the Pythagorean Theorem and its converse to solve problems in two and three dimensions, for example, to determine lengths of diagonals of rectangles and right rectangular prisms, and to estimate distances between points in the coordinate plane.

In the third section, students see that “cube root of n ” and $\sqrt[3]{n}$ mean the side length of a cube with volume n cubic units. They also represent a cube root as a decimal approximation and as a point on the number line.

In the fourth section, students consider the decimal expansions of rational and irrational numbers. They learn how to rewrite fractions as a repeating decimal, how to rewrite a repeating decimal as a fraction, and reinforce their understanding that irrational numbers have a place on the number line even if they cannot be written as a fraction of integers.

Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
<p>Grade 8 Unit 5</p> <p>Section D Volume (Lessons 11-16)</p> <p>Section E Dimensions and Spheres (Lessons 17-21)</p>	<p>Learning Target #1 Calculate the value of one dimension of a cylinder or cone, and explain the reasoning.</p> <p>Learning Target #2 Calculate the volume of a cylinder or cone.</p>	<p>Lesson 13 The Volume of a Cylinder</p> <ul style="list-style-type: none"> I can find the volume of a cylinder in mathematical and real-world situations. I know the formula for the volume of a cylinder. <p>Lesson 14 Finding Cylinder Dimensions</p> <ul style="list-style-type: none"> I can find missing information about a cylinder if I know its volume and some other information. <p>Lesson 15 The Volume of a Cone</p> <ul style="list-style-type: none"> I can find the volume of a cone in mathematical and real-world situations. I know the formula for the volume of a cone. <p>Lesson 16 Finding the Cone Dimensions</p> <ul style="list-style-type: none"> I can find missing information about a cone if I know its volume and some other information. <p>Lesson 20 The Volume of a Sphere</p> <ul style="list-style-type: none"> I can find the volume of a sphere when I know the radius. <p>Lesson 21 Cylinders, Cones, and Spheres</p> <ul style="list-style-type: none"> I can find the radius of a sphere if I know its volume. I can solve mathematical and real-world problems about the volume of cylinders, cones, and spheres.
<p>Grade 8 Unit 5 Checkpoint D & E</p>	<p><i>Responding to Student Thinking</i> Checkpoint D Points to Emphasize: If most students struggle with using the formula for volume of a cylinder, revisit this skill throughout the next section. For example, during the Activity Synthesis of the activity referred to here, invite 1–3 students to share how they calculated the volume of the cylinder. Grade 8, Unit 5, Lesson 19, Activity 3 Estimating Hemispheres</p> <p>Checkpoint E Press Pause: If most students struggle with using the formula for volume, make time to do some or all of this optional lesson: Grade 8, Unit 5, Lesson 22 Volume as a Function of . . .</p>	
<p>Grade 8 Unit 8</p> <p>Section A Side Lengths and Areas of Squares (Lessons 1-6)</p>	<p>Learning Target #3 Comprehend the term “irrational number” to mean a number that is not rational and that $\sqrt{2}$ is an example of an irrational number.</p> <p>Learning Target #4 Comprehend the term “square root of n” and the notation \sqrt{n} to</p>	<p>Lesson 3 Square Roots</p> <ul style="list-style-type: none"> I can find a decimal approximation for square roots. <p>Lesson 4 Rational and Irrational Numbers</p> <ul style="list-style-type: none"> I know what an irrational number is and can give an example. I know what a rational number is and can give an example. <p>Lesson 6 Reasoning About Square Roots</p> <ul style="list-style-type: none"> I can find a decimal approximation for square roots. I can plot square roots on the number line. When I have a square root, I can reason about which two whole numbers it is between.

	mean the side length of a square whose area is n square units. Learning Target #5 Use the square root symbol to represent solutions to equations of the form $x^2=n$ and represent the square root as a point on the number line.	
Grade 8 Unit 8 Checkpoint A	<i>Responding to Student Thinking</i> More Chances: Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.	
Grade 8 Unit 8 Section B The Pythagorean Theorem (Lessons 7-13)	Learning Target #6 Calculate the distance between two points in the coordinate plane by using the Pythagorean Theorem. Learning Target #7 Explain an area-based algebraic proof of the Pythagorean Theorem. Learning Target #8 Use the Pythagorean Theorem to calculate unknown side lengths of right triangles and to solve problems within a context. Learning Target #9 Coordinate representations of a cube root, including cube root notation, decimal representation, the edge length of a cube of given volume, and a point on the number line.	Lesson 9 Finding Unknown Side Lengths <ul style="list-style-type: none"> If I know the lengths of two sides, I can find the length of the third side in a right triangle When I have a right triangle, I can identify which side is the hypotenuse and which sides are the legs. Lesson 10 The Converse <ul style="list-style-type: none"> I can explain why it is true that if the side lengths of a triangle satisfy the equation $a^2 + b^2 = c^2$ then it must be a right triangle. If I know the side lengths of a triangle, I can determine if it is a right triangle or not. Lesson 11 Applications of the Pythagorean Theorem <ul style="list-style-type: none"> I can use the Pythagorean Theorem to solve problems. Lesson 13 Finding Distances in a Coordinate Plane <ul style="list-style-type: none"> I can find the distance between two points in the coordinate plane. I can find the length of a diagonal line segment in the coordinate plane. Lesson 15 Cube Roots <ul style="list-style-type: none"> When I have a cube root, I can reason about which two whole numbers it is between.
Grade 8 Unit 8 Checkpoint B Problems 1 & 2 only	<i>Responding to Student Thinking</i> <ul style="list-style-type: none"> Problem 1: Press Pause: By this point in the unit, there should be some student mastery with using the Pythagorean Theorem. If most students struggle, revisit related work. For example, in the practice problem referred to here, review how to use the Pythagorean Theorem when finding a leg versus when finding the hypotenuse. Problem 2: Points to Emphasize: If most students struggle with finding the distance between two points, revisit how constructing a right triangle allows for the use of the Pythagorean Theorem. For example, in the practice problem referred to here, ask students to sketch a graph of the pairs of points when finding the distance between them. 	
End of Unit Assessment		

Unit Title:

Unit 8: Introduction to Quadratic Functions (iM U7)

Relevant Standards: Bold indicates priority

Lesson	Standards	Lesson	Standards
Lesson 1	HSF-BF.A.1.a	Lesson 10	HSA-SSE.B.3
Lesson 2	HSA-SSE.A.1, HSA-SSE.B.3, HSF-BF.A.1.a, HSF-IF.A.3	Lesson 11	HSA-SSE.A, HSF-IF.C.7.a
Lesson 3	HSA-SSE.A.1, HSF-BF.A.1.a, HSF-IF.A.2	Lesson 12	HSF-BF.B.3, HSF-IF.C, HSF-IF.C.7, HSF-LE.A.2
Lesson 4	HSF-BF.A.1.a, HSF-IF.C, HSF-LE.A.3	Lesson 13	HSA-SSE.B.3, HSF-BF.B.3, HSF-IF.C.7, HSF-IF.C.7.a
Lesson 5	HSF-BF.A.1.a, HSF-IF.A.2	Lesson 14	HSF-IF.A.2, HSF-IF.B.4, HSF-IF.C.7.a, HSF-IF.C.8, HSF-IF.C.9
Lesson 6	HSF-BF.A.1, HSF-BF.A.1.a, HSF-IF.B.5, HSF-IF.C, HSF-IF.C.7.a	Lesson 15	HSF-BF.B.3, HSF-IF.C, HSF-IF.C.7.a
Lesson 7	HSF-BF.A.1.a, HSF-IF.B.5, HSF-IF.C.7.a	Lesson 16	HSF-IF.C, HSF-IF.C.7.a
Lesson 8	HSA-APR.A, HSA-SSE.A, HSA-SSE.A.2, HSA-SSE.B.3	Lesson 17	HSF-BF.B.3, HSF-IF.C, HSF-IF.C.7.a
Lesson 9	HSA-APR.A, HSA-SSE.A.2, HSA-SSE.B.3		

Essential Question(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?

Enduring Understanding(s):

- 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:

Checkpoint A: Opportunity for Feedback (after Lesson 2)
 CFA 1: Checkpoint B(after Lesson 7)
 Checkpoint C: Opportunity for Feedback (after Lesson 10)
 Mid-Unit Assessment (after Lesson 10)
 CFA 2: Checkpoint D (after Lesson 17)
 End-of-Unit Assessment (after Lesson 17)

Pacing for Unit

23 Days
 Lessons to Add/Review:

- If students need additional support with combining like terms or applying the distributive property, Grade 7 Unit 6 Lessons 18–22 address these topics.
- The Algebra 1 Extra Supports materials, particularly Lessons 1 and 3, provide additional material for students who may need resources to support their understanding of area and perimeter.

 Lesson Modifications:

- Combine Lessons 1 and 2. Emphasize Activities 2.2 and 2.3.
- Combine Lessons 3 and 4. Emphasize Activity 4.2 and the idea that exponential functions always eventually grow more quickly than quadratic functions.

	<ul style="list-style-type: none"> Remove Lesson 7. This focuses on quadratic functions in the context of price versus revenue. Remove Lesson 13. This focuses on the effect of the linear term in quadratic functions and is beyond the scope of Algebra 1 standards. Remove Lessons 15–17. These lessons introduce vertex form. While vertex form is important, the lessons in the first sections of Unit 7 are higher priority for Algebra 1 students. 																																	
Family Overview	Integration of Technology:																																	
https://accessim.org/9-12-aga/algebra-1/unit-7?a=family	<ul style="list-style-type: none"> Desmos Online Graphing Calculator Pear Assessment (Edulastic) iM v.360 Digital Applets (see below) 																																	
Unit-specific Vocabulary:	Aligned Unit Materials, Resources, and Technology																																	
Quadratic expression, quadratic function, vertex, zero, factored form, standard form, vertex form	<p>Digital Applets</p> <ul style="list-style-type: none"> Alg1.7.11 Digital Activity 2: What Do We Need to Sketch a Graph? Alg1.7.12 Digital Activity 1: Quadratic Graphs Galore Alg1.7.17 Digital Activity 2: A Peanut Jumping over a Wall <p>Provide access as needed throughout the unit:</p> <ul style="list-style-type: none"> Colored pencils Graphing technology Graph paper Math Community Chart <table border="1"> <thead> <tr> <th>Lesson</th> <th>Materials to Gather</th> <th>Materials to Copy</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Graph paper: Activity 1</td> <td></td> </tr> <tr> <td>4</td> <td>Graphing technology: Activity 1, Activity 2</td> <td></td> </tr> <tr> <td>6</td> <td>Graphing technology: Activity 1, Activity 2</td> <td></td> </tr> <tr> <td>11</td> <td> <ul style="list-style-type: none"> Colored pencils: Activity 1 Graphing technology: Activity 2 </td> <td></td> </tr> <tr> <td>12</td> <td>Graphing technology: Activity 1, Activity 2</td> <td>Representations of Quadratic Functions Cards (1 copy for every 2 students): Activity 3</td> </tr> <tr> <td>13</td> <td>Graphing technology: Activity 1, Activity 2</td> <td></td> </tr> <tr> <td>14</td> <td>Graphing technology: Warm-up, Activity 1</td> <td>Rocket Math Cards (1 copy for every 2 students): Activity 3</td> </tr> <tr> <td>15</td> <td>Graphing technology: Activity 2</td> <td></td> </tr> <tr> <td>16</td> <td></td> <td>Matching Equations with Graphs Cards (1 copy for every 2 students): Activity 2</td> </tr> <tr> <td>17</td> <td> <ul style="list-style-type: none"> Graphing technology: Activity 1, Activity 2, Activity 3 Math Community Chart: Activity 2 </td> <td></td> </tr> </tbody> </table>	Lesson	Materials to Gather	Materials to Copy	1	Graph paper: Activity 1		4	Graphing technology: Activity 1, Activity 2		6	Graphing technology: Activity 1, Activity 2		11	<ul style="list-style-type: none"> Colored pencils: Activity 1 Graphing technology: Activity 2 		12	Graphing technology: Activity 1, Activity 2	Representations of Quadratic Functions Cards (1 copy for every 2 students): Activity 3	13	Graphing technology: Activity 1, Activity 2		14	Graphing technology: Warm-up, Activity 1	Rocket Math Cards (1 copy for every 2 students): Activity 3	15	Graphing technology: Activity 2		16		Matching Equations with Graphs Cards (1 copy for every 2 students): Activity 2	17	<ul style="list-style-type: none"> Graphing technology: Activity 1, Activity 2, Activity 3 Math Community Chart: Activity 2 	
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<p>Science</p> <ul style="list-style-type: none"> 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. <p>Economics & Business</p> <ul style="list-style-type: none"> 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. <p>Computer Science & Engineering</p> <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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. <p>See teacher's guide for specific misconceptions aligned to each lesson.</p>
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Connections to Prior Units:	Connections to Future Units:
<p>Essential prior concepts to engage with this unit:</p> <ul style="list-style-type: none"> Write equivalent expressions by combining like terms and applying the distributive property. <p>Relevant Unit(s)/Lesson(s) to Review:</p> <ul style="list-style-type: none"> Grade 7, Unit 6: Expressions, Equations, and Inequalities 	<p>Connections to Units in Future Courses</p> <p>Transformations of Functions</p> <ul style="list-style-type: none"> 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. <p>Circles, Higher-Degree Polynomials, and Rational Expressions</p> <ul style="list-style-type: none"> 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. <p>Logarithms and Advanced Growth Models</p> <ul style="list-style-type: none"> 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. <p>Inverse Functions</p> <ul style="list-style-type: none"> The concept of inverse functions expands into logarithmic inverses of exponentials and inverse trigonometric functions in Algebra 2.

Differentiation through *Universal Design for Learning*

<p>Engagement:</p> <ul style="list-style-type: none"> Leverage choice by inviting students to select specific graphs to match with their equations (Lesson 13, Activity 2 Launch) <p>Representation:</p> <ul style="list-style-type: none"> Provide a graphic organizer for individual sketches and observations of parameter changes (Lesson 12, Activity 1 Launch) <p>Action & Expression:</p> <ul style="list-style-type: none"> Chunk graphing tasks into parts and encourage pattern sharing with partners (Lesson 11, Activity 1 Launch)

Supporting Multilingual Learners

<p>Math Language Routines</p> <p>The Illustrative Mathematics curriculum incorporates eight Mathematical Language Routines (MLRs) that support English Language Learners:</p> <p>MLR1: <i>Stronger and Clearer Each Time</i> - Students revise and refine their mathematical language through multiple drafts</p> <p>MLR2: <i>Collect and Display</i> - Students capture and organize language in visual displays</p> <p>MLR3: <i>Clarify, Critique, Correct</i> - Students analyze mathematical writing/talk</p> <p>MLR4: <i>Information Gap</i> - Students share information to solve problems</p> <p>MLR5: <i>Co-Craft Questions</i> - Students create and improve questions</p> <p>MLR6: <i>Three Reads</i> - Students analyze complex mathematical text</p>

MLR7: *Compare and Connect* - Students connect different mathematical representations
 MLR8: *Discussion Supports* - Students participate in mathematical discussions

In this unit:

- MLR1: Stronger and Clearer Each Time (Lessons 9, 16)
- MLR2: Collect and Display (Lessons 3, 5, 11, 12, 14)
- MLR6: Three Reads (Lesson 17)
- MLR7: Compare and Connect (Lesson 8)
- MLR8: Discussion Supports (Lessons 1, 2, 12, 13, 15)

Sentence Frames and Stems

Section A

- This pattern represents a _____ relationship because ...
- Using the _____ I see that the pattern is growing by ...
- The expression _____ represents this situation because ...

Section B

- The expression _____ represents this situation because ...
- When the input is _____, the output for the function _____ is greater/less than the output for the function _____ because ...
- The height of the _____ after _____ is _____ because ...
- The function _____ represents this situation because ...

Section C

- If the factored form of a quadratic expression is _____, then the standard form is _____ because ...
- In this situation, the _____ (feature of the graph) represent(s) _____ because ...
- The equation _____ defines the function of the graph shown because ...

Section D

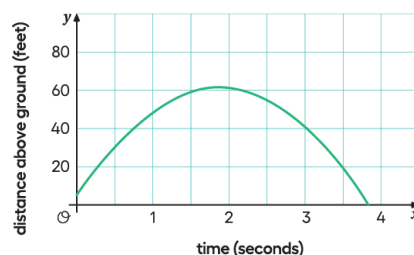
- When the equation is written in _____ form, I can easily identify the _____ (feature of the graph) which is _____ because ...
- In the equation _____, if the value _____ is changed to _____, the graph changes by ...
- To graph the function _____, first I _____, then I ...
- In this situation, the _____ (feature of the graph) represent(s) _____ because ...

Unit Outline

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. They further observe that eventually these quadratic patterns grow more quickly than do linear patterns but more slowly than exponential patterns grow.

Students examine the important example of free-falling objects whose height over time can be modeled with quadratic functions. They use tables, graphs, and equations to describe the movement of these objects, eventually looking at the situation in which a projectile is launched upward. They interpret the meaning of each term in this context and work toward understanding how the coefficients influence the shape of the graph. Additional situations, such as revenue and area, are also introduced.

Next, students examine standard, factored, and vertex forms of quadratic functions. They recognize what information about the graph is easily obtained from each form and how the different values in each form influence the graph. In particular, they begin to generalize ideas of how horizontal and vertical translation, as well as vertical and horizontal stretching of graphs, relate to modifying the equation of a function.



Note on materials: Access to graphing technology is necessary for many activities. Examples of graphing technology are: a handheld graphing calculator, a computer with a graphing calculator application installed, and an internet-enabled device with access to a site like [desmos.com/calculator](https://www.desmos.com/calculator) or [geogebra.org/graphing](https://www.geogebra.org/graphing). For students using the digital version of these materials, a separate graphing calculator tool isn't necessary. Interactive applets are embedded throughout, and a graphing calculator tool is accessible in the student math tools.

Lesson Sequence	Learning Target(s)	Success Criteria/Assessment
Section A: A Different Kind of Change Lessons 1-2	Learning Target #1 I can comprehend that a "quadratic relationship" can be expressed with a squared term. Learning Target #2 I can determine and explain whether a visual pattern	Lesson 1 A Different Kind of Change <ul style="list-style-type: none"> • 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 How Does It Change? <ul style="list-style-type: none"> • I can describe how a pattern is growing. <div style="border: 1px solid red; padding: 2px;">Checkpoint B Problem 1</div>

	represents a linear, exponential, or quadratic relationship.	<p>Middle of Unit Problem 1</p> <ul style="list-style-type: none"> I can tell whether a pattern is growing linearly, exponentially, or quadratically. <p>Checkpoint A Middle of Unit Problem 1</p> <ul style="list-style-type: none"> I know a quadratic expression has a squared term. <p>Checkpoint A</p>
Checkpoint A	<p><i>Responding to Student Thinking</i></p> <p>More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time.</p>	
<p>Section B: Quadratic Functions Lessons 3-7</p>	<p>Learning Target #3 I can interpret quadratic functions that represent a physical phenomenon, given expressions and graphs.</p> <p>Learning Target #4 I can use graphs, tables, and calculations to show that exponential functions eventually overtake quadratic functions.</p>	<p>Lesson 3 Building Quadratic Functions from Geometric Patterns</p> <ul style="list-style-type: none"> I can explain using graphs, tables, or calculations that exponential functions eventually grow faster than quadratic functions. <p>Middle of Unit Problem 5</p> <ul style="list-style-type: none"> I can recognize quadratic functions written in different ways. I can use information from a pattern of shapes to write a quadratic function. <p>Middle of Unit Problem 1</p> <p>Lesson 4 Comparing Quadratic and Exponential Functions</p> <ul style="list-style-type: none"> I can explain using graphs, tables, or calculations that exponential functions eventually grow faster than quadratic functions. <p>Middle of Unit Problem 5</p> <p>Lesson 5 Building Quadratic Functions to Describe Situations (Part 1)</p> <ul style="list-style-type: none"> I can explain the meaning of the terms in a quadratic expression that represents the height of a falling object. <p>Checkpoint B Problem 2 Middle of Unit Problem 2</p> <ul style="list-style-type: none"> I can use tables, graphs, and equations to represent the height of a falling object. <p>Lesson 6 Building Quadratic Functions to Describe Situations (Part 2)</p> <ul style="list-style-type: none"> 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. <p>Middle of Unit Problem 2</p> <p>Lesson 7 Building Quadratic Functions to Describe Situations (Part 3)</p> <ul style="list-style-type: none"> I can choose a domain that makes sense in a revenue situation. <p>Middle of Unit Problem 7</p> <ul style="list-style-type: none"> I can model revenue with quadratic functions and graphs. <p>Middle of Unit Problem 4 <i>NOTE: Middle of Unit Problem 4 Test question context is area but the Lesson is based on revenue, may want to preview revenue.</i> Middle of Unit Problem 7</p>

		<ul style="list-style-type: none"> I can relate the vertex of a graph and the zeros of a function to a revenue situation.
Checkpoint B	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Points to Emphasize: If students struggle to describe why exponential growth is eventually faster than quadratic growth, plan to revisit the idea throughout the rest of the unit. For example, as students explore graphs of quadratic functions in the lesson referred to here, use different functions of the form $y=ab^x$ to show that the exponential functions eventually grow faster. Algebra 1, Unit 7, Lesson 10 Graphs of Functions in Standard and Factored Forms Problem 2: More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time. 	
<p>Section C: Working with Quadratic Expressions Lessons 8-10</p>	<p>Learning Target #5 I can coordinate a quadratic expression given in factored form and the intercepts of its graph.</p> <p>Learning Target #6 I can use the distributive property to write equivalent quadratic expressions from factored into standard form.</p>	<p>Lesson 8 Equivalent Quadratic Expressions</p> <ul style="list-style-type: none"> 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 <p>Lesson 9 Standard Form and Factored Form</p> <ul style="list-style-type: none"> 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 <p>Lesson 10 Graphs of Functions in Standard and Factored Forms</p> <ul style="list-style-type: none"> 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 <i>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.</i> 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
MOU (after lesson 10)		
Checkpoint C	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> More Chances: Students will have more opportunities to develop this understanding in later sections. There is no need to slow down or add additional work to review this concept at this time. 	
<p>Section D: Features of Graphs of Quadratic Functions Lessons 11-17</p>	<p>Learning Target #7 I can explain how a graph is affected by changing parameters in quadratic expressions written in standard, factored, and vertex forms.</p> <p>Learning Target #8</p>	<p>Lesson 11 Graphing from the Factored Form</p> <ul style="list-style-type: none"> 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.

	<p>I can use an equation in vertex form to identify the maximum or minimum of a quadratic function.</p>	<div style="border: 1px solid red; padding: 2px;">End of Unit Problem 4 End of Unit Problem 5</div> <p>Lesson 12 Graphing the Standard Form (Part 1)</p> <ul style="list-style-type: none"> I can explain how the a and c in $y = ax^2 + bx + c$ affect the graph of the equation. <div style="border: 1px solid red; padding: 2px;">Checkpoint D Problem 1 End of Unit Problem 3</div> <ul style="list-style-type: none"> I understand how graphs, tables, and equations that represent the same quadratic function are related. <p>Lesson 13 Graphing the Standard Form (Part 2) (Optional)</p> <ul style="list-style-type: none"> 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. <div style="border: 1px solid red; padding: 2px;">End of Unit Problem 1 End of Unit Problem 2</div> <p>Lesson 14 Graphs That Represent Situations (Optional)</p> <ul style="list-style-type: none"> I can explain how a quadratic equation and its graph relate to a situation. <div style="border: 1px solid red; padding: 2px;">End of Unit Problem 5</div> <p>Lesson 15 Vertex Form</p> <ul style="list-style-type: none"> 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. <div style="border: 1px solid red; padding: 2px;">End of Unit Problem 2 End of Unit Problem 6</div> <p>Lesson 16 Graphing from the Vertex Form (Optional)</p> <ul style="list-style-type: none"> 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. <div style="border: 1px solid red; padding: 2px;">Checkpoint D Problem 2 End of Unit Problem 6</div> <p>Lesson 17 Changing the Vertex</p> <ul style="list-style-type: none"> I can describe how changing a number in the vertex form of a quadratic function affects its graph. <div style="border: 1px solid red; padding: 2px;">End of Unit Problem 6</div>
<p>Checkpoint D</p>	<p><i>Responding to Student Thinking</i></p> <ul style="list-style-type: none"> Problem 1: Press Pause: If students struggle to describe how graphs of quadratic functions differ based on the functions, make time to explore the idea further. For example, revisit the digital form of the activity referred to here to explore how changing the parameters influence the graph. Algebra 1, Unit 7, Lesson 11, Problem 2: Press Pause: If students struggle to identify the maximum or minimum of a quadratic function in vertex form, plan to make time to revisit the idea. For example, use the optional lesson referred to here to practice connecting the equation of the quadratic function with the graph that represents it. 	
<p>End of Unit Assessment</p>		