Unit 3
Extensions of Linear Concepts

Algebra I

Students continue their study of linear concepts by learning about piecewise-defined linear functions, linear inequalities with one or two variables, and systems of linear equations and inequalities. Students will solve systems of linear equations and inequalities in a variety of ways.

Standards for Mathematical Practice

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.

Louisiana Student Standards for Mathematics (LSSM)

Parts of standards that are addressed in later units have been ~~crossed out~~.

F – Functions IF – Interpreting Functions	
A. Understand the concept of a function and use function notation.	
F-IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
B. Interpret functions that arise in application in terms of the context.	
F-IF.B.4	For linear, piecewise linear (to include absolute value), and exponential functions that model a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. ★
F-IF.B.6	Calculate and interpret the average rate of change of a linear, piecewise linear (to include absolute value), and exponential function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ★
C. Analyze functions using different representations.	

F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ **a.** Graph linear functions and show intercepts, maxima, and minima. **b.** Graph piecewise linear (to include absolute value) and exponential functions.
F-IF.C.9	Compare properties of two functions (linear, quadratic, piecewise linear [to include absolute value] or exponential) each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, determine which has the larger maximum.
F – Functions **LE – Linear, Quadratic, and Exponential Models** (Exponential Models will be addressed in Unit 4 Quadratic Models will be addressed in Unit 5)	
B. Interpret expressions for functions in terms of the situation they model.	
F-LE.B.5	Interpret the parameters in a linear, quadratic, or exponential function in terms of a context.
CED – Creating Equations	
A. Create equations that describe numbers or relationships.	
A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A-CED.A.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. ★
REI – Reasoning with Equations and Inequalities	
B. Solve equations and inequalities in one variable.	
A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
C. Solve systems of equations.	
A-REI.C.5	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
A-REI.C.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
D. Represent and solve equations and inequalities graphically.	
A-REI.D.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
A-REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are

	the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, piecewise linear (to include absolute value), and exponential functions. ★
A-REI.D.12	Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

***As defined by LSSM, the basic modeling cycle involves:**
1. identifying variables in the situation and selecting those that represent essential features,
2. formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables,
3. analyzing and performing operations on these relationships to draw conclusions,
4. interpreting the results of the mathematics in terms of the original situation,
5. validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable,
6. reporting on the conclusions and the reasoning behind them.

Choices, assumptions, and approximations are present throughout this cycle.

Enduring Understandings:

*A piecewise linear function is broken into several pieces, and each piece is defined by a linear function.
*Piecewise linear functions may be continuous or discontinuous.
*Some real-world relationships can be represented by linear inequalities.
*Two linear functions pertaining to the same data can be used to model situations where the result is the intersection of the two functions.

Essential Questions:

*What types of real-world data can be expressed using a piecewise linear function?
*How is the shading for a linear inequality determined?
*What are the possible solutions to a linear system of equations? Explain.