Topic C

Function Transformations and Modeling

A-CED.A.2, F-IF.B.6, F-IF.C.7b, F-IF.C.8a, F-IF.C.9, F-BF.B.3

Focus Standards:	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.★
	F-IF.B.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★
	F-IF.C.7b	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
	F-IF.C.8a	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
	F-IF.C.9	Compare properties of two functions 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, say which has the larger maximum.*
	F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x)+k$, $kf(x)$, $f(kx)$, and $f(x+k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
Instructional Days:	7	
Lesson 18:	Graphing Cubic, Square Root, and Cube Root Functions (E)[1]	
Lesson 19:	Translating Graphs of Functions (P)	

[1]Lesson Structure Key: **P**-Problem Set Lesson, **M**-Modeling Cycle Lesson, **E**-Exploration Lesson, **S**-Socratic Lesson

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Lesson 20:	Stretching and Shrinking Graphs of Functions (E)
Lesson 21:	Transformations of the Quadratic Parent Function, $f(x) = x^2$ (P)
Lesson 22:	Comparing Quadratic, Square Root, and Cube Root Functions Represented in Different Ways (E)
Lessons 23–24:	Modeling with Quadratic Functions (M, P)

In Lesson 18 of this topic, students build an understanding of the transformational relationship between basic quadratic and square root functions, as well as cubic and cube root functions. (Note: Square and cube roots are not treated as inverse functions in this course but rather as rotations and reflections of quadratic and cubic functions.) The topic builds on students' prior experience of transforming linear, exponential, and absolute value functions in Module 3 to include transforming quadratic, square root, and cube root functions in Lessons 19 and 20. Students create graphs of quadratic, square root, and cube root functions by recognizing in the given functions a parent function along with the transformations to be performed. Students also write the function of the given graph by recognizing the parent function and different transformations being performed. It is crucial that students understand that complex functions can be built from basic parent functions and that this recognition can simplify both graphing functions and creating function equations from graphs. They recognize the application of transformations in the vertex form for the quadratic function and use it to expand their ability to efficiently sketch graphs of square root and cube root functions.

In Lesson 21, students use what they know about transformations of functions to build both graphs and new, related functions from the quadratic parent function. Then, in Lesson 22, they compare key features of three functions (quadratic, square root, or cube root), each represented in a different way, including graphically, algebraically, numerically in tables, or verbally with a description.

In the final two lessons, students create quadratic functions from contextual situations described verbally and from data sets, create graphs of their functions, interpret key features of both the functions and their graphs in terms of the contexts, and answer questions related to the functions and their graphs. They justify their solutions, as well as choose and explain the level of precision they used in reporting their results.

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