

Core Content

Cluster Title: Analyze functions using different representations.
Standard F.IF.7: 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. e) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
Concepts and Skills to Master
<ul style="list-style-type: none"> Graph functions stated F.IF.7 (b) and (e) by hand, given an equation. Use technology to graph functions stated in F.IF.7 (b) and (e) for more complicated cases. Find and interpret key features of functions stated in F.IF.7 (b) and (e).

Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> Modeling trigonometric functions (Secondary II: F.TF.5) Graphing and identifying key features in linear, exponential, quadratic, and piecewise functions by hand and with technology (Secondary I: F.IF.7, Secondary II: F.IF.7) Understanding transformations of linear, exponential, quadratic, and piecewise functions (Secondary I: F.BF.3, Secondary II: F.BF.3) 	
Academic Vocabulary	
square root, cube root, piecewise, logarithmic, step, absolute value, discrete, continuous, discontinuous, maximum, minimum, increasing, decreasing, period, midline, amplitude, frequency, transformation, axis of symmetry, domain, range, end behavior, $ x $, \sqrt{x} , $\sqrt[3]{x}$,	
Suggested Instructional Strategies	Resources
	<ul style="list-style-type: none"> Math Shell—Functions and Everyday Situations
Sample Formative Assessment Tasks	
Skill-Based Task: Graph the function and identify key features: $f(x) = \sin(x + 4) - 2$	Problem Task: Graph a sine, cosine, and tangent function that all have the same period.

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Standard F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
Concepts and Skills to Master
<ul style="list-style-type: none"> Write an equivalent form of a function defined by an expression for functions given in Secondary III: F.IF.7 (b) and (e) as well as simple rational. <ul style="list-style-type: none"> Identify zeros, transformations, points of discontinuity, and asymptotes when suitable factorizations are available. Use properties of logarithms to write equivalent forms. Transition between equivalent forms to identify desired key features.

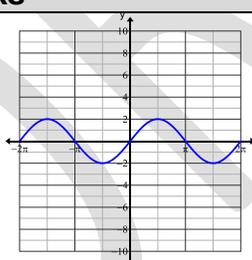
Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> Factor and complete the square to find key features of quadratics (Secondary II: F.IF.8) Dividing polynomials (Secondary III: A.APR.6) Trigonometric identities (Secondary II: F.TF.8) 	
Academic Vocabulary	
zeros, transformation, point of discontinuity, asymptote (vertical, horizontal, oblique), period, midline, amplitude, maximum, minimum, end behavior	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> Teach in conjunction with A.APR.6. 	
Sample Formative Assessment Tasks	
Skill-Based Task: Write the function $f(x) = \frac{x^2+x-6}{x^2-x-2}$ in factored form to identify any asymptotes and points of discontinuity.	Problem Task: You have a box with dimensions 1'x2'x3'. The sides begin to increase by a length 1' each minute. Write a function expressing this relationship in at least two different but equivalent forms. Relate key features of the graph to the equations.

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Standard F.IF.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i>
Concepts and Skills to Master
<ul style="list-style-type: none"> Compare properties of two functions, where one is represented algebraically, graphically, numerically in tables, or by verbal descriptions and the other is modeled using a different representation.

Supports for Teachers

Critical Background Knowledge													
<ul style="list-style-type: none"> Expressing functions using multiple representations 													
Academic Vocabulary													
extreme value, intercept, asymptote, end behavior, average rate of change, intervals of increase or decrease, discontinuity, domain, range, period, midline, amplitude, frequency													
Suggested Instructional Strategies	Resources												
<ul style="list-style-type: none"> Examine the benefits and drawbacks of using various representations of functions. 													
Sample Formative Assessment Tasks													
<p>Skill-Based Task: Compare the amplitudes and periods of the functions.</p> $f(x) = 2\sin\left(x + \frac{\pi}{2}\right)$ 	<p>Problem Task: Identify the similarities and differences between the two polynomial functions.</p> $f(x) = x^3 - 2x^2 - 2x + 4$ <table border="1" data-bbox="1617 958 1827 1201"> <thead> <tr> <th colspan="2">Quadratic</th> </tr> <tr> <th>x</th> <th>$f(x)$</th> </tr> </thead> <tbody> <tr> <td>-2</td> <td>-8</td> </tr> <tr> <td>1</td> <td>-5</td> </tr> <tr> <td>3</td> <td>7</td> </tr> <tr> <td>4</td> <td>16</td> </tr> </tbody> </table>	Quadratic		x	$f(x)$	-2	-8	1	-5	3	7	4	16
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