

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. ★
a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
Concepts and Skills to Master
<ul style="list-style-type: none"> Graph quadratic functions expressed in various forms by hand. Use technology to model quadratic functions, when appropriate. Graph and find key features of piecewise-defined functions, including step functions and absolute value functions.

Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> Graph linear and exponential functions showing key features (I.2.F.IF.7). Interpret key features of a graph (II.2.F.IF.4). Identify and use transformation of functions (II.2.F.BF.3). 	
Academic Vocabulary	
piecewise, step function, axis of symmetry, absolute value, $ x $	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> Find real-world contexts that motivate the use of step functions. Compare the absolute value function to its piecewise definition. 	
Sample Formative Assessment Tasks	
Skill-Based Task: Graph the function and identify the key features. $f(x) = \begin{cases} x+2 & x \leq 1 \\ x^2 - 3 & x > 1 \end{cases}$	Problem Task: Write and graph three different functions whose minimum is (-1,5).

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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.	
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.	
b. Use the properties of exponents to interpret expressions for exponential functions. (For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.)	
Concepts and Skills to Master	
<ul style="list-style-type: none"> Factor quadratics and complete the square (with II.2.A.SSE.3) to find intercepts, extreme values, and symmetry of the graph. Transition between different forms of quadratic functions and identify the advantages of each. 	
Supports for Teachers	
Critical Background Knowledge	
<ul style="list-style-type: none"> Identify key features of a quadratic function (II.F.IF.7). Multiply binomials. 	
Academic Vocabulary	
binomial, trinomial, perfect square trinomial, completing the square, zero, extreme values (maximum and minimum), vertex, axis of symmetry	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> Use manipulatives for multiplying, factoring, and completing the square. Create a graphic organizer comparing all three forms of quadratic functions. 	Virtual Manipulatives (NLVM: Algebra Tiles)
Sample Formative Assessment Tasks	
Skill-Based Task: Factor the expression: $2x^2 - 9x - 5$ Transform $f(x) = x^2 + x - 12$ into another form to identify the zeros. Transform $f(x) = x^2 + x - 12$ into another form to identify the vertex.	Problem Task: You are the head of the marketing department at Harmonix, and have just determined your revenue can be modeled by the function $r(x) = -10x^2 + 100x - 210$, where x is the amount spent on advertising in thousands of dollars. Determine an advertising budget.

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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). (For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.)
Concepts and Skills to Master
<ul style="list-style-type: none"> Compare intercepts, maxima and minima, rates of change, and end behavior of two quadratic 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"> Find intercepts, rates of change, end behavior, extreme values, and symmetry of quadratic functions (II.2.F.IF.4). 															
Academic Vocabulary															
intercepts, rates of change, end behavior, extreme values, symmetry															
Suggested Instructional Strategies	Resources														
<ul style="list-style-type: none"> Use technology to transition between forms of a function. Match functions expressed using different representations that have the same properties. Compare two functions expressed in different representations. Ask: Which is growing at a faster rate? Which one has a higher initial value? Why does it increase faster than the other? How do you know? 															
Sample Formative Assessment Tasks															
<p>Skill-Based Task: Which has a greater average rate of change over the interval [5,10]?</p> <p>$f(x) = x^2 + 4$ or</p> <table border="1"> <thead> <tr> <th>time</th> <th>f(t)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>300</td> </tr> <tr> <td>5</td> <td>777.5</td> </tr> <tr> <td>10</td> <td>1010</td> </tr> <tr> <td>15</td> <td>997.5</td> </tr> <tr> <td>20</td> <td>740</td> </tr> <tr> <td>25</td> <td>237.5</td> </tr> </tbody> </table>	time	f(t)	0	300	5	777.5	10	1010	15	997.5	20	740	25	237.5	<p>Problem Task: Represent two quadratic functions with a minimum of (0,2), one expressed in function notation and the other in a table.</p>
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