Build a function that models a relationship between two quantities. Develop models for more complex or sophisticated situations (F.BF.1)
Standard III.F.BF.1: Write a function that describes a relationship between two quantities.▢   **b.** Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Concepts and Skills to Master
• Combine functions using addition, subtraction, multiplication, or division. Use functions from Secondary I, Secondary II, and Secondary III.

Related Standards: Current Course	Related Standards: Future Courses
III.F.BF.all, III.F.IF.all, III.F.LE.3, III.F.TF.5	P.F.BF.1, P.F.BF.4, P.F.TF.7

Support for Teachers

Critical Background Knowledge
• Use function notation (I.F.IF.2)
• Combine functions using arithmetic operations (I.F.BF.3 and II.F.BF.1)

Academic Vocabulary

Resources
Curriculum Resources: http://www.uen.org/core/core.do?courseNum=5630#71635

Build new functions from existing functions (F.BF.3-4)
Standard III.F.BF.3: Identify the effect on the graph of replacing *f(x) by f(x) + k, k f(x), f(kx), and f(x+k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Note the effect of multiple transformations on a single function and the common effect of each transformation across function types. Include functions defined only by a graph. 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.*
Concepts and Skills to Master
- Describe verbally and graphically what will happen when $f(x)$ is replaced by $f(x) + k, k f(x), f(kx), and f(x+k),$ where *k* is any real number. Use all functions studied in Secondary I, Secondary II, and Secondary III.   - Perform transformations (including multiple transformations) on any function with and without technology.   - Recognize even and odd functions from their graphs and algebraic expressions.   - Given a graph of *f(x)* and *f(x) + k, k f(x), f(kx), or f(x+k),* on the same coordinate axis, find the value of *k.*

Related Standards: Current Course	Related Standards: Future Courses
III.A.SSE.1, III.F.IF.7, III.F.IF.8, III.F.IF.9	P.N.VM.5, P.N.VM.7, P.N.VM.8, P.F.TF.4

Support for Teachers

Critical Background Knowledge
- Understanding transformations on functions (I.F.BF.3 and II.F.BF.3)   - Recognize even and odd functions from a graph and as algebraic expressions (II.F.BF.3)   - Graph functions with and without technology (I.F.IF.7 and II.F.IF.7)   - Use geometric descriptions of rigid motions to transform figures and predict the effect of transformation (I.G.CO.6)
Academic Vocabulary
even function, odd function, dilation
Resources
Curriculum Resources: http://www.uen.org/core/core.do?courseNum=5630#71635

Build new functions from existing functions (F.BF.3-4)
Standard III.F.BF.4: Find inverse functions.   **a.** Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. Include linear, quadratic, exponential, logarithmic, rational, square root, and cube root functions. *For example,* f(x) = 2x^3 *or* f(x) = (x+1)/(x-1) *for* x ≠ 1.

Concepts and Skills to Master
• Write an expression for the inverse of a function. • Consider examining a function and its inverse using numerical, graphical, and algebraic representations. • Finding the inverse in Secondary III is a basic exposure to conceptually understand the relationship between a function and its inverse. (Precalculus addresses the following inverse concepts: produce an invertible function from a non-invertible function by restricting the domain, read values of an inverse from a graph or table, and verify by composition that one function is the inverse of another).

Related Standards: Current Course	Related Standards: Future Courses
III.A.CED.3, III.A.CED.4, III.F.IF.7, III.F.IF.9, III.F.LE.4, III.F.TF.7	P.F.BF.4c, P.F.BF.4d, P.A.REI.9, P.F.TF.6

Support for Teachers

Critical Background Knowledge (Access Background Knowledge)
• Understand that a function from one set (domain) to another set (range) assigns each element of the domain to exactly one element of the range (8.F.1 and I.F.IF.1) • Use function notation (I.F.IF.2) • Relate domain of a function to its graph (I.F.IF.5 and II.F.IF.5) • Rearrange a formula for a specified variable (I.A.CED.4 and II.A.CED.4) • Interpret key features of graphs and tables in terms of quantities (I.F.IF.4 and II.F.IF.4)
Academic Vocabulary
inverse, $f(x), f^{-1}(x)$, one-to-one
Resources
Curriculum Resources: http://www.uen.org/core/core.do?courseNum=5630#71635