Core Content

Cluster Title: Build a function that models a relationship between two quantities.

Standard F.BF.1: Write a function that describes a relationship between two quantities.★
    a. Determine an explicit expression, a recursive process, or steps for calculation from a context.
    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
• Given a linear or exponential context, find an expression, recursive process, or steps to model a context with mathematical representations. • Combine linear and/or exponential functions using addition, subtraction, multiplication, and division.

Supports for Teachers

Critical Background Knowledge
• Simplifying expressions
Academic Vocabulary
Function, intercepts, explicit expression, recursive

Suggested Instructional Strategies	Resources
• Toothpick Patterns • Number of knots versus length of rope • Give examples and use arithmetic operations to linear and exponential functions to fit the data.	www.illuminations.NCTM.org • Function Matching *Making It Happen* (NCTM)

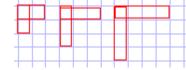| Sample Formative Assessment Tasks	
Skill-based Task If $f(x) = x + 4$ and $g(x) = 3x - 5$, find $(f + g)(x)$ Anne is shopping and finds a $30 sweater on sale for 20% off. When she buys the sweater, she must also pay 6% sales tax. Write an expression for the final price of the sweater in such a way that the original price is still evident. (Extension: If the clerk just adds 14% will the price be correct?)	**Problem Task** Find an expression, process or calculation to determine the number of squares needed to make the next three patterns in the series.

★Modeling

I.2.Function. Building Functions

Core Content

Cluster Title: Build a function that models a relationship between two quantities.
Standard F.BF.2: Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★
Concepts and Skills to Master
• Write arithmetic sequences both recursively and with an explicit formula. • Write geometric sequences both recursively and with an explicit formula. • Model contextual situations with arithmetic or geometric sequences.

Supports for Teachers

Critical Background Knowledge	
• Identify arithmetic and geometric sequences	
Academic Vocabulary	
Arithmetic sequence, geometric sequence, recursive, explicit	
Suggested Instructional Strategies	**Resources**
• Use tables to elicit the difference between recursive and explicit formulas for the same pattern. • Write recursive and explicit formulas for patterns made by adding toothpicks to existing patterns. • Match sequences expressed recursively with those expressed explicitly.	www.illuminations.NCTM.org • Trout Pond Practice with Arithmetic and Geometric Sequences Word Problems http://www.regentsprep.org/Regents/math/algtrig/ATP2/SequenceWordpractice.htm
Sample Formative Assessment Tasks	

Skill-based Task • Write two formulas that model the pattern. 3, 9, 27, 81……	Problem Task Continue the pattern for two more iterations graphically and then find a recursive or explicit formula to model the situation.

★Modeling

I.2.Function. Building Functions

Core Content

Cluster Title: Build new functions from existing functions.
Standard 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. 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
• Perform vertical translations on linear and exponential graphs.   • Find the value of k given f(x) replaced by f(x) + k on a graph of a linear or exponential function.   • Relate the vertical translation of a linear function to its y-intercept.   • Describe what will happen to a function when $f(x)$ is replaced by $f(x)+k$ for different values of k.

Supports for Teachers

Critical Background Knowledge
• Graphing linear and exponential functions
Academic Vocabulary
Translation, transformation, y-intercept, vertical shift

Suggested Instructional Strategies	Resources
• Use graphing technology to explore translations of functions.	www.shodor.org/

Sample Formative Assessment Tasks	
Skill-based Task Graph the following on a single set of axes: $f(x) = 2^x$ $f(x) = 2^x + 1$ $f(x) = 2^x + 2$ $f(x) = 2^x - 1$ $f(x) = 2^x - 2$	**Problem Task** Compare and contrast the graph of any function, $f(x)$, and the graph of $f(x)+k$.