Task Model 1 **Response Type: Equation/Numeric** **DOK Level 2** **F-BF.A.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. **Evidence Required:** 1. The student writes explicit or recursive functions to describe relationships between two quantities from a context. **Tools:** Calculator	**Prompt Features:** The student is prompted to enter a function that represents a relationship between two quantities by determining an explicit function that represents a context. **Stimulus Guidelines:** The student is presented with a contextual situation that describes a relationship between two quantities that can be modeled by a function. • Functions can be linear, quadratic, exponential, or rational. • Difficulty level can be altered by varying the type of function and context. **TM1a** **Stimulus:** The student is presented with a contextual situation. **Example Stem 1:** Maria is making a rectangular garden. The length of the garden is 2 yards greater than its width, *w*, in yards. Enter the function, *f*(*w*), that describes the area, in square yards, of Maria's garden as a function of the width, *w*. **Example Stem 2:** Barb traveled 300 miles during the first 5 hours of her trip. Barb then traveled at a constant speed of 50 miles per hour for the remainder of the trip. Enter the function, *f*(*t*), that describes the average speed during the entire trip as a function of time, *t*, in hours, Barb traveled after her first 300 miles. **Example Stem 3:** A washing machine was purchased for $256. Each year the value is $\frac{1}{4}$ of its value the previous year. Enter the function, *f*(*t*), that describes the value of the washing machine, in dollars, as a function of time in years, *t*, after the initial purchase. **Rubric:** (1 point) The student correctly enters the function describing the relationship between two quantities in the given contextual situation (e.g., $f(w) = w(w+2)$; $f(h) = \frac{300+50h}{5+h}$; $f(t) = \$256(0.75)^t$). **Response Type:** Equation/Numeric

<table>
<tr>
<td>Task Model 1

Response Type: Equation/Numeric

DOK Level 2

F-BF.A.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.

Evidence Required:
1. The student writes explicit or recursive functions to describe relationships between two quantities from a context.

Tools: Calculator

Version 3 Update:
Retired TM1b Example Stem 2.</td>
<td>Prompt Features: The student is prompted to enter a function that describes a relationship between two quantities by determining a recursive rule that represents a context.

Stimulus Guidelines: The student is presented with a contextual situation that describes a relationship between two quantities that can be modeled by a function.
• Function types can include linear or exponential.
• Difficulty level can be altered by varying the type of function and context.

TM1b
Stimulus: The student is presented with a contextual situation.

Example Stem: A researcher studies the growth of a fruit fly population. The researcher counts the number of fruit flies at noon each day. The results are in the table.

<table>
<tr><th>Day</th><th>Number of Fruit Flies</th></tr>
<tr><td>0</td><td>4</td></tr>
<tr><td>1</td><td>8</td></tr>
<tr><td>2</td><td>16</td></tr>
<tr><td>3</td><td>32</td></tr>
</table>

• $V(n)$= Total number of fruit flies after n days
• $V(0) = 4$

Enter the function for $n \geq 1,$ which describes the number of fruit flies, $V(n)$, at noon on the n^{th} day in terms of the number of fruit flies at noon on the previous day, $V(n-1)$.

Rubric: (1 point) Student correctly enters the function describing the relationship between two quantities in the given contextual situation [e.g., V(n) = 2V(n – 1)].

Response Type: Equation/Numeric</td>
</tr>
</table>

Task Model 1 **Response Type: Equation/Numeric** **DOK Level 2** **F-BF.A.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. **Evidence Required:** 1. The student writes explicit or recursive functions to describe relationships between two quantities from a context. **Tools:** Calculator	**Prompt Features:** The student is prompted to model a given contextual situation as a sequence using either a recursively defined function or an explicitly defined function. **Stimulus Guidelines:** The student is presented with a contextual description of two quantities. • The context can be modeled by: ○ an arithmetic sequence ○ a geometric sequence ○ Items may also draw upon knowledge contained in F-IF.A.3. • Difficulty level can be altered by varying the complexity of function and context. **TM1c** **Stimulus:** The student is presented with a contextual situation. **Example Stem 1:** The first row in a theater has 8 seats, the second row has 11 seats, the third row has 14 seats and the fourth row has 17 seats. The pattern of increasing each successive row by 3 seats continues throughout the theater. • $f(r)$ = the number of seats in row r. • $f(1) = 8$ Enter an equation, for $r \geq 2$, which describes the number of seats, $f(r)$, in the rth row in terms of the number of seats in the $(r - 1)$th row, $f(r - 1)$. **Example Stem 2:** The 13th row in a theater has 41 seats, the 12th row has 38 seats, the 11th row has 35 seats and the 10th row has 32 seats. The pattern of decreasing each successive row by 3 seats continues from the 13th row to the 1st row. • $f(r)$ = the number of seats in row r. • $f(1) = 5$ Enter an equation, for $r \geq 2$, that describes the number of seats, $f(r)$, in the rth row in terms of the number of seats in the $(r - 1)$th row, $f(r - 1)$. Assume that the pattern described applies to all rows. **Rubric:** (1 point) Student correctly represents the sequence with a recursively defined function [e.g., $f(r) = f(r - 1) + 3$; $f(r) = f(r - 1) + 3$]. **Response Type:** Equation/Numeric

Task Model 2 **Response Type:** **Multiple Choice, single correct response** **DOK Level 2** **F-BF.A.2** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. **Evidence Required:** 2. The student translates between recursive functions and explicit functions. **Tools:** Calculator	**Prompt Features:** The student is prompted to select a recursive or explicit function that is equivalent to a given function. **Stimulus Guidelines:** • Sequences can be either arithmetic or geometric in a given item. • Domain should only include integers. • a_1 needs to be less than or equal to ±20. • Difference between numbers in arithmetic sequence should be less than or equal to five. • Difficulty level can be altered by varying the type of function and context. **TM2a** **Stimulus:** The student is presented with an explicit or recursively defined function. **Example Stem 1:** Consider this function in explicit form. $f(n) = 3n - 4;\ n \geq 1$ Select the equivalent recursively defined function. A. $f(1) = -1$ $f(n) = f(n-1) + 3;\ n \geq 2$ B. $f(1) = -1$ $f(n) = 3f(n-1);\ n \geq 2$ C. $f(0) = -4$ $f(n) = 3f(n-1);\ n \geq 2$ D. $f(0) = -4$ $f(n) = f(n-1) + 3;\ n \geq 2$ **Example Stem 2:** Consider this function in recursive form. $f(1) = -3$ $f(n) = 3f(n-1);\ n \geq 2$ Select the equivalent explicit function for $n \geq 1$. A. $f(n) = -3(n)$ B. $f(n) = -3(n-1)$ C. $f(n) = -3(3)^n$ D. $f(n) = -3(3)^{(n-1)}$ **Rubric:** (1 Point) Student selects the correct choice (e.g., A; D). **Response Type:** Multiple Choice, single correct response

Task Model 2

Response Type:
Matching Tables

DOK Level 2

F-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

Evidence Required:
2. The student translates between recursive functions and explicit functions.

Tools: Calculator

Prompt Features: The student is prompted to match explicitly defined functions with their equivalent recursive form.

Stimulus Guidelines:

- All explicit functions will have an equivalent recursive function.
- Sequences can be either arithmetic or geometric in a given item.
- Domain should only include integers, excluding rational numbers.
- a_1 needs to be less than or equal to ±20.
- Difference between numbers in arithmetic sequence should be less than or equal to five.
- Difficulty level can be altered by varying the type and complexity of function.

TM2b
Stimulus: The student is presented with explicit and recursive functions.

Example Stem: The functions in the table are defined for integers $n \geq 1$. Match each recursively defined function with the equivalent explicit form.

Functions	$f(n) = 3(10)^{(n-1)}$; $n \geq 1$	$f(n) = 3n + 7$; $n \geq 1$	$f(n) = 10(3)^{(n-1)}$; $n \geq 1$
$f(1) = 10$ $f(n) = 3f(n-1)$; $n \geq 2$			
$f(1) = 3$ $f(n) = 10f(n-1)$; $n \geq 2$			
$f(1) = 10$ $f(n) = f(n-1) + 3$; $n \geq 2$			

Click the appropriate box that matches the recursive form in the first column with its equivalent explicit form in the top row.

Interaction: The student is presented with three explicit functions in the first row and three recursive functions in the first column. The student selects the cell in the table that matches the functions.

Rubric:
(1 point) Student correctly matches all functions (e.g., see below).

	<table><tr><th>Functions</th><th>$f(n) = 3(10)^{(n-1)}$; $n \geq 1$</th><th>$f(n) = 3n + 7$; $n \geq 1$</th><th>$f(n) = 10(3)^{(n-1)}$; $n \geq 1$</th></tr><tr><td>$f(1) = 10$ $f(n) = 3f(n - 1)$; $n \geq 2$</td><td></td><td></td><td></td></tr><tr><td>$f(1) = 3$ $f(n) = 10f(n - 1)$; $n \geq 2$</td><td></td><td></td><td></td></tr><tr><td>$f(1) = 10$ $f(n) = f(n - 1) + 3$; $n \geq 2$</td><td></td><td></td><td></td></tr></table> **Response Type:** Matching Tables

Task Model 3

Response Type:
Fill-in Table

DOK Level 2

F-BF.A.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.

Evidence Required:
3. The student understands a function as a model of the relationship between two quantities.

Tools: Calculator

Version 3 Update:
Retired TM3a

Prompt Features: The student is prompted to model a given contextual situation as a sequence given a recursively defined function.

Stimulus Guidelines:

- The student is presented with a contextual description of two quantities that can be modeled by:
  - an arithmetic sequence
  - a geometric sequence
  - Items may also draw upon knowledge contained in F-IF.A.3.
- Difficulty level can be altered by varying the type of function and context.

TM3b
Stimulus: The student is presented with a contextual situation.

Example Stem: A theater needs to place seats in rows. The function, $f(r)$, as shown below, can be used to determine the number of seats in each row, where r is the row number.

$f(1) = 8$
$f(r) = f(r-1) + 3$

Use the function to complete the table indicating the number of seats in each of the first four rows of the theater.

Row number	Number of Seats
Row 1	
Row 2	
Row 3	
Row 4	

Rubric: (1 point) Student correctly enters the sequence from the recursive form into the table (e.g., see below).

Row number	Number of Seats
Row 1	8
Row 2	11
Row 3	14
Row 4	17

Response Type: Fill-in Table