CH.4, L3 – LINEAR VS. EXPONENTIAL RECURSIVE FUNCTIONS

Objective: Given an arithmetic or geometric sequence or function, I will identify the recursive formula by evaluating the function for different terms in the sequence or input values.

Think About It:

Part A: Write out a sequence of the first 5 outputs of $f(x) = 2x$ starting with $f(1)$. If you only knew the value of $f(15)$, how could you determine $f(16)$?

Sequence: _____

_____

_____

_____

_____

Key Point #2:

Part B: Write out a sequence of the first 5 outputs of $g(x) = 2^x$ starting with $f(1)$. If you only knew the value of $g(15)$, how could you determine $g(16)$?

Sequence: _____

_____

_____

_____

_____

Key Point #2:

Keywords: *outputs, previous output*

Big Idea:

CFS:

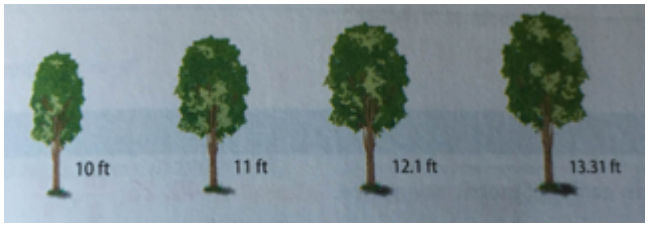
1. Table is created if not given
2. Table or sequence shows if the function is arithmetic/linear or geometric/exponential
3. Recursive functions have initial value and recursive rule
4. Explicit functions are in linear or exponential form

Interaction with New Material:

Ex. 1) Given the recursive function defined below, determine the value of a(5). Explain if this recursive function represents a linear or exponential relationship.

$a(1) = 8, \qquad a(n) = a(n-1) + 2.75$

Ex. 2) The diagram below shows the height of a tree every year where the first tree represents the height at year 1. Which of the following recursive functions could be used to describe the height of the tree, $h(n)$, after *n* years?



a. $h(1) = 10,\ h(n) = (1.1)h(n-1)$
b. $h(0) = 10,\ h(n) = (1.1)h(n-1)$
c. $h(1) = 10,\ h(n) = h(n-1) + 1.1$
d. $h(1) = 13.31,\ h(n) = h(n-1) + 1.1$

CHECK:

CFS:

1. Table is created if not given
2. Table or sequence shows if the function is arithmetic/linear or geometric/exponential
3. Recursive functions have initial value and recursive rule
4. Explicit functions are in linear or exponential form

Partner Practice: *(Low Difficulty)*

1. For each recursive function below, create a table of values that define the first five numbers in the sequence.

a. $f(1) = 8,$ $f(x) = f(x-1) + 10$	b. $g(1) = 3,$ $g(x) = 2g(x-1)$

2. For the functions in question 1, explain if each function represents a linear or exponential relationship and justify your answer. Write the explicit functions for each function respectively.

_____

_____

_____

_____

_____

3. Which recursive function accurately represents the table below?

f(n)	5	7	9	11	13
n	1	2	3	4	5

a. $f(1) = 5, \quad f(n) = f(n-1) + 5$

b. $f(1) = 2, \quad f(n) = f(n-1) + 5$

c. $f(1) = 5, \quad f(n) = f(n-1) + 2$

d. $f(1) = 2, \quad f(n) = f(n-1) + 5$

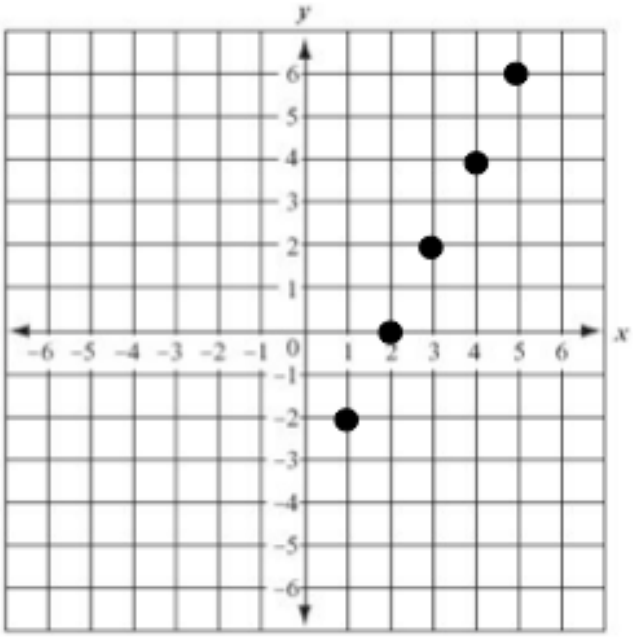
CFS:

1. Table is created if not given
2. Table or sequence shows if the function is arithmetic/linear or geometric/exponential
3. Recursive functions have initial value and recursive rule
4. Explicit functions are in linear or exponential form

(Medium Difficulty)

4. Which recursive function could be used to define the relationship in the graph?

a. $g(1) = 1, \quad g(n) = g(n-1) - 2$
b. $g(0) = -2, \quad g(n) = 2g(n-1)$
c. $g(1) = -2, \quad g(n) = 2g(n-1)$
d. $g(1) = -2, \quad g(n) = g(n-1) + 2$



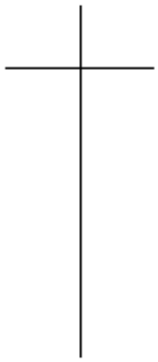
5. Given the functions below, evaluate $f(4) + g(4)$

$$f(2) = 9, \quad f(n) = f(n-1) + 11$$
$$g(3) = 11, \quad g(n) = 5g(n-1)$$

1. Table is created if not given
2. Table or sequence shows if the function is arithmetic/linear or geometric/exponential
3. Recursive functions have initial value and recursive rule
4. Explicit functions are in linear or exponential form

6. Josh is working in a lab and studying growing bacteria. At the first hour, there were 20 cells of bacteria. After two hours, the bacteria had increased to 30 cells. At the third hour, there were 45 cells. Determine which recursive function could be used to model the growth and prove it is correct. Explain if this is linear or exponential growth and why.

   a. $c(1) = 10, c(h) = c(h-1) + 10$
   b. $c(1) = 20, c(h) = 1.5c(h-1)$
   c. $c(1) = 20, c(h) = c(h-1) + 15$
   d. $c(1) = 30, c(h) = c(h-1) - 10$



CHECK:

_____

_____

_____

_____

7. Explain how you can tell if a recursive function represents a linear or exponential relationship by only looking at the structure of the function. How does this reinforce what you know about linear and exponential functions?

_____

_____

_____

_____

_____

_____

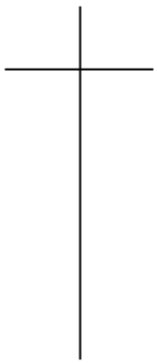
_____

CFS:

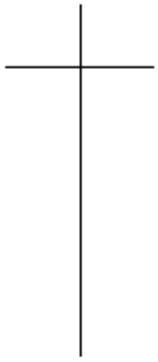
1. Table is created if not given
2. Table or sequence shows if the function is arithmetic/linear or geometric/exponential
3. Recursive functions have initial value and recursive rule
4. Explicit functions are in linear or exponential form

(Hard Difficulty)

8. Given the two functions below, create a table for integer values of x on the interval $1 \leq x \leq 5$. Use your table to write a recursive function for each function given.
   a. $f(x) = 3x + 4$



   b. $g(x) = \frac{1}{2}(2)^x$



9. Explain how you were able to write the recursive function from an explicit function.

_____

_____

_____

_____

_____

CFS:

1. Table is created if not given
2. Table or sequence shows if the function is arithmetic/linear or geometric/exponential
3. Recursive functions have initial value and recursive rule
4. Explicit functions are in linear or exponential form