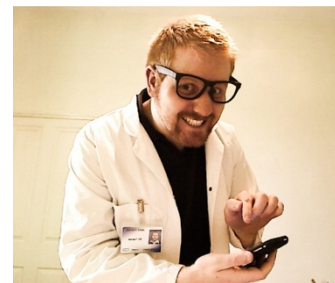


4.8 Efficiency Experts

A Solidify Understanding Task



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In our work so far, we have worked with linear and exponential equations in many forms. Some of the forms of equations and their names are:

| Equation | Name |
|---|---|
| $y = \frac{1}{2}x + 1$ | Slope Intercept Form $y = mx + b$, where m is the slope and b is the y-intercept |
| $y - 3 = \frac{1}{2}(x - 4)$ | Point Slope Form $y - y_1 = m(x - x_1)$, where m is the slope and (x_1, y_1) the coordinates of a point on the line |
| $x - 2y = -2$ | Standard Form $ax + by = c$ |
| $f(0) = 1, f(n) = f(n - 1) + \frac{1}{2}$ | Recursion Formula $f(n) = f(n - 1) + D$, Given an initial value $f(a)$ D = constant difference in consecutive terms |

1. Verify that the four equations above are equivalent.
2. Explain how you know that the four equations are linear.

You have been appointed as a mathematics efficiency expert. Your job is to compare these four forms of equations for different uses and decide which form is most efficient and effective for each use. The investigation will be conducted in four parts with a report to be written at the end.



Linear Investigation Part A: Which form best tells the story?

1. In his job selling vacuums, Joe makes \$500 each month plus \$20 for each vacuum he sells. Which equation best describes Joe's monthly income?

$$20x - y = 500$$

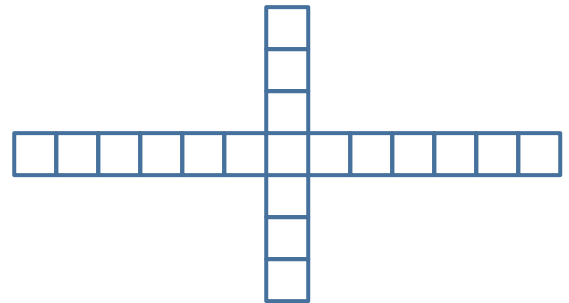
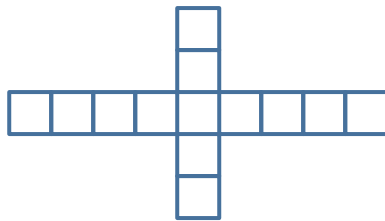
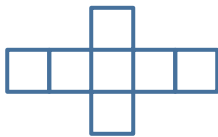
$$y = 20x + 500$$

2. The Tree Hugger Granola Company makes trail mix with candies and nuts. The cost of candies for a trail mix is \$2 per pound and the cost of the nuts is \$1.50 per pound. The total cost of a batch of trail mix is \$540. Which equation best models the quantities of candies and nuts in the mix?

$$2x + 1.5y = 540$$

$$y = \frac{4}{3}x + 360$$

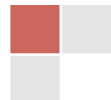
3. Grandma Billings is working on a quilt with blocks in the following pattern. Which equation best models the number of blocks in each pattern?



$$f(n) = 6n + 1$$

$$f(1) = 7, f(n) = f(n - 1) + 6$$

4. What is the important difference between the type of situations that can be modeled with a recursion formula and the other equation forms?



Linear Investigation Part B: Which is the best form for writing equations?

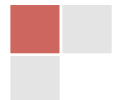
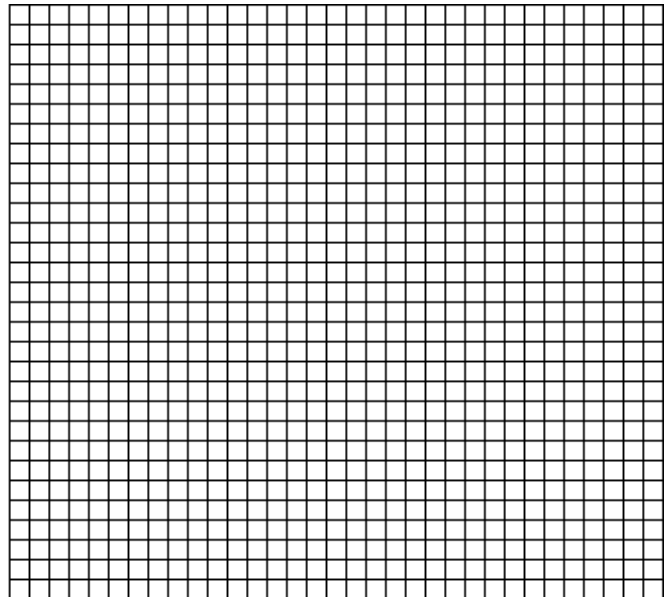
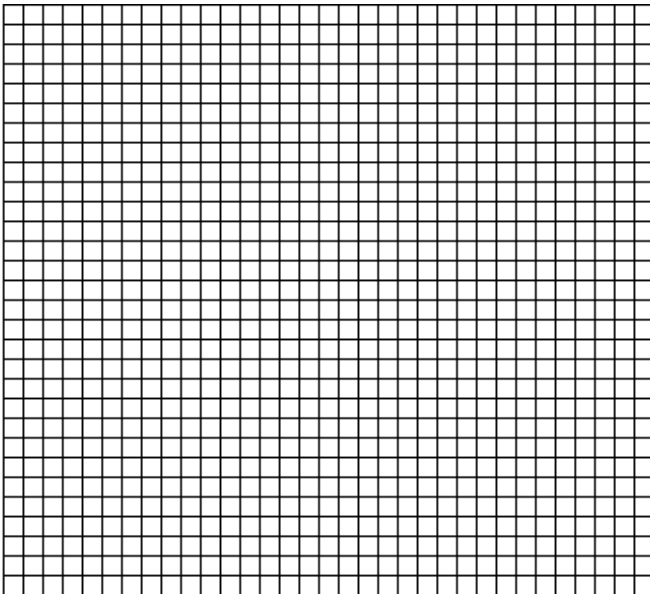
1. Write the equation of the line with a slope of -2 through the point (-2, 5)
2. Write the equation of the line through the points (1, -2) and (4, 1)
3. Write the equation of the arithmetic sequence that starts with -7 and each term decreases by 3.

Linear Investigation Part C: Which is the best form for graphing?

Graph the following equations:

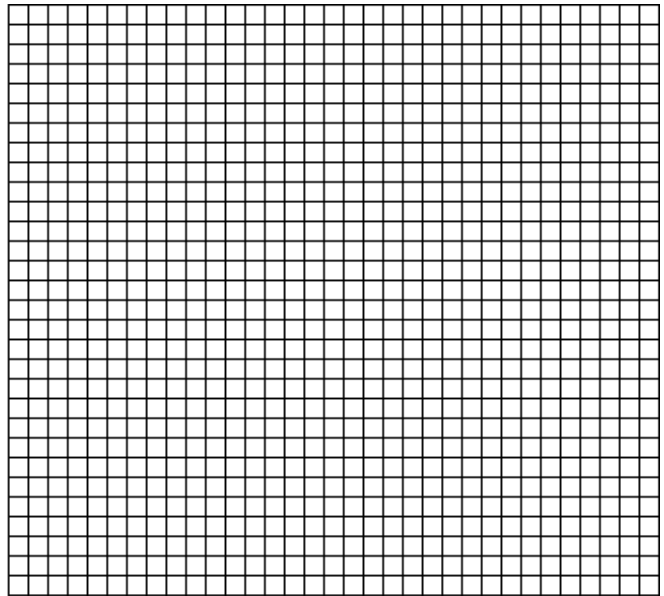
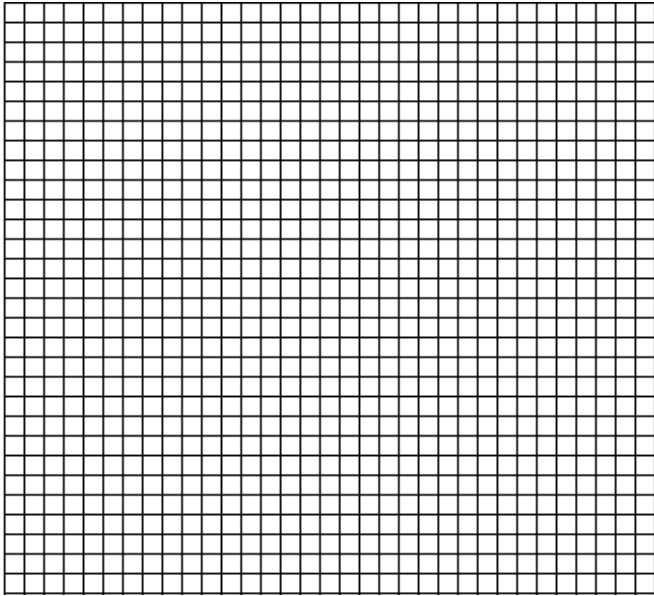
1. $y = \frac{3}{4}x + 5$

2. $3x - 5y = 15$



3. $f(n) = -4(n + 6) + 5$

4. $f(0) = -2, f(n) = f(n - 1) - 5$



Linear Investigation Part D: What about tables?

1. Create a table for each equation.

a. $-x + 2y = 6$

b. $y = -\frac{1}{2}x - 4$

2. Write an equation for the relation described in this table.

| x | y |
|-----|-----|
| 12 | -3 |
| 9 | -8 |
| 6 | -13 |
| 3 | -18 |
| 0 | -23 |



Your Efficiency Analysis Report, Part 1

Using the results of your investigation, describe the best uses for each form of an equation of a line, with sections for standard form, slope intercept form, point slope form and recursion formulas. Be sure to include a discussion of tables, graphs, and story contexts as part of your report.

Investigating Exponential Forms

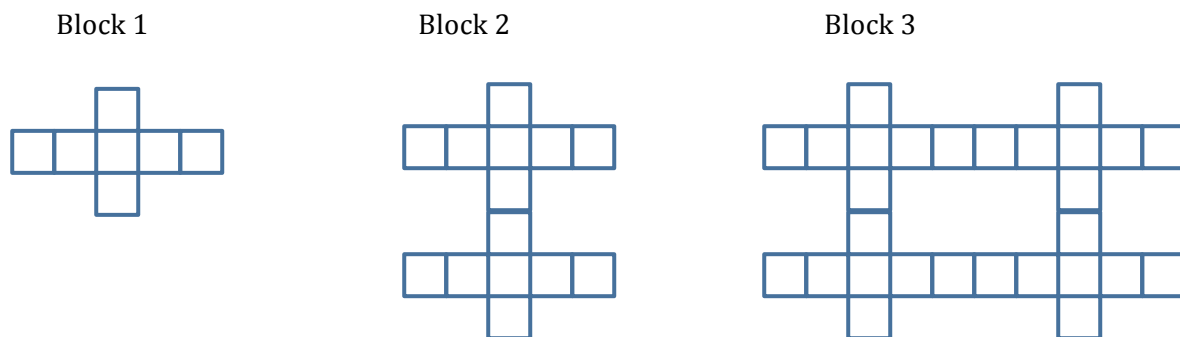
During the course of the year, we have also worked with forms of exponential equations, with a few more coming before the end of the module. The forms of exponential equations that we have seen so far:

| Equation | Name |
|-------------------------------|--|
| $y = 10(3)^x$ | Explicit Form $y = a(b)^x$ |
| $f(0) = 10, f(n + 1) = 3f(n)$ | Recursion Formula $f(n + 1) = Rf(n)$ Given an initial value $f(a)$ $R =$ constant ratio between consecutive terms |

Test out the efficiency of these two exponential equation types for these tasks.

Exponential Investigation Part A: Which form tells the story best?

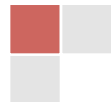
- Grandma Billings has started piecing her quilt together and has created the following growth pattern:



Which equation best models the number of squares in each block?

$$f(n) = 7(2)^{n-1}$$

$$f(1) = 7, f(n) = 2f(n - 1)$$



2. The population of the resort town of Java Hot Springs in 2003 was estimated to be 35,000 people with an annual rate of increase of about 2.4%. Which equation best models the number of people in Java Hot Springs, with t = the number of years from 2003?

$$f(t) = 35,000(1.024)^t \quad f(0) = 35,000, f(t) = 1.024 \cdot f(t - 1)$$

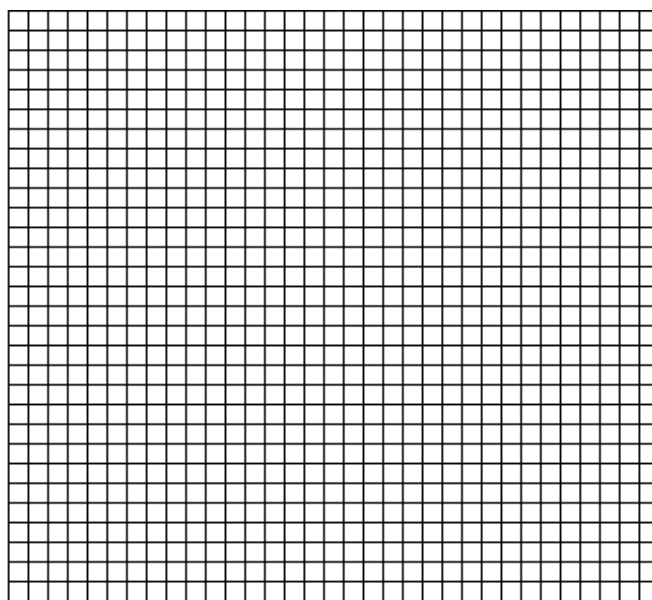
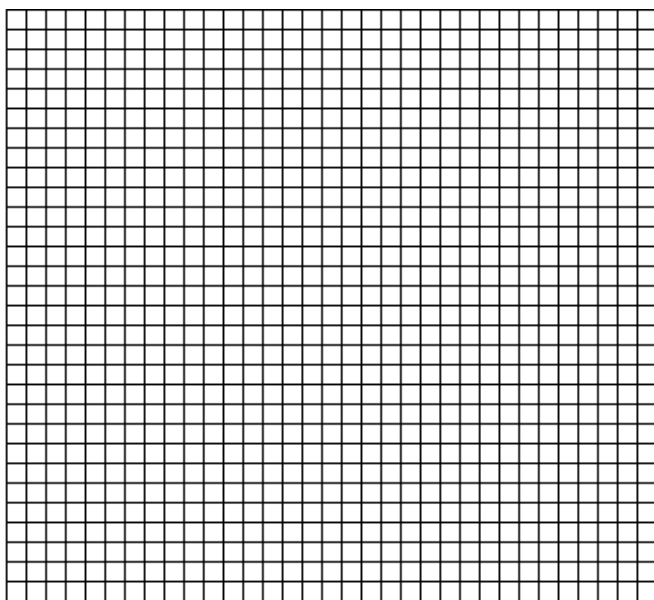
3. How would you have to change the definition of t in the recursive formula to model the situation?

Exponential Investigation Part B: Which is the best form for graphing?

Graph each equation:

1. $y = 2(1.8)^x$

2. $f(0) = 5, f(n) = 0.6 \cdot f(n - 1)$



Your Efficiency Analysis Report, Part 2

Using the results of your investigation, describe the best uses for each form of an exponential equation, with sections for standard form and recursion formulas. Be sure to include a discussion of tables, graphs, and story contexts as part of your report.

