Building a Linear Model: Stacking Books

1. Place one of your text books on a desk and measure the height (in centimeters to the nearest tenth of a cm) from the floor to the top edge of the book and record the distance.

   _____

2. Place a second book on the stack and measure the height (in centimeters) from the floor to the top edge of the second book and record that distance. _____

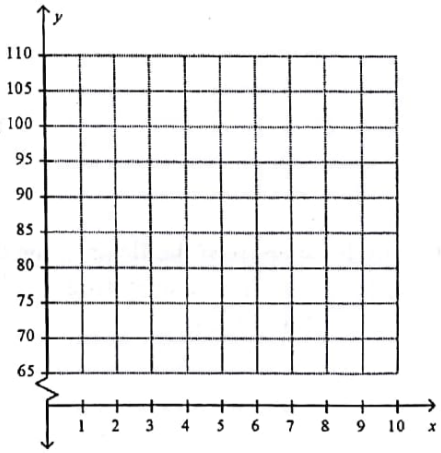
3. Continue that procedure until you have measured the height of a stack of 5 books and recorded the measurements in the table below. Then plot the points on the grid.

Number of Books	Height above Floor (cm)
1	
2	
3	
4	
5	

4. What patterns do you notice that might help you figure out the relationship between the height of the stack and the number of books in the stack?

5. Make a graph of the data your group collected. Make sure to label your axes. Would it be appropriate to connect the data points?

6. Predict, without measuring, the height of a stack of 9 books. Explain how you arrived at your prediction.



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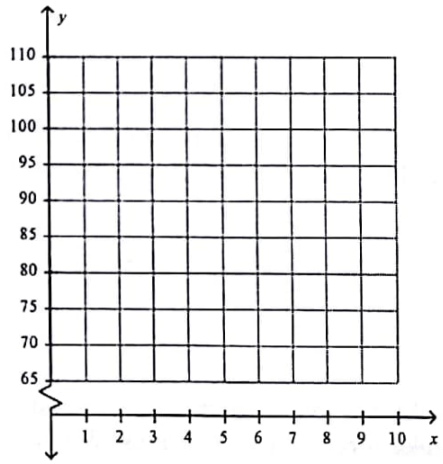
7. Predict, without measuring, the height of a stack of 20 books. Explain how you arrived at your prediction.

8. Write an equation that gives the height of a stack of books, h, in terms of n, the number of books in the stack.

   What is the meaning of the coefficients used in your equation?

9. Use the equation you just wrote to find h when $n = 9$ and when $n = 20$. Do your answers to this question agree with your predictions in #6 and #7?

10. Sketch a graph of the equation you wrote in #8. How does this graph compare to the graph you made in #5?



11. The distance from the floor to the ceiling in this room is 250 centimeters. If we stack books on the top of a desk as before, explain how we could determine the number of books needed to reach the ceiling.

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12. Suppose that you started stacking books on the top of the filing cabinet rather than on the desk. What part of the equation (#8) would change? What would the new equation be?

13. Now suppose that you stacked your English books instead of your math textbooks. If you begin stacking on your desk again, what part of your equation would change now? How does this affect the graph?

14. Every night, I read a book that is part of a mystery series. Afterwards, I stack the books on my dresser. If my dresser is 90 centimeters high, and each mystery is 1.5 centimeters thick, write an equation for the total height (h) of my book stack after n books.

15. The equation $h = 3.2n + 64$ represents the height of another stack of n books, where the measurements were again made in centimeters. What does this equation tell about this stack of books?

16. Suppose the graph of a similar book stacking model has a slope of 4 and a y-intercept of 0.
    a) What would the slope represent in the context of the problem?

    b) Where did this stack begin?

    c) What would be the height of the stack after 10 books?

    d) Write an equation for the height of the stack after n books.

17. In general, to write an equation for a linear relationship, what two items do we need to know, and what does each item tell us?

Extension

1. Jimmy was working on a similar book stacking assignment and has collected the data shown in the table below. What information can we gather from Jimmy's table?

Number of Books	0	1	2	3	4	5
Height (cm)	50.0	53.5	57.0	60.5	64.0	67.5

   a) Sketch a graph of this relationship on grid paper. Make sure to label your axes.

   b) What is the y-intercept of this graph? What does this point tell us about Jimmy's stack?

   c) What is the slope of Jimmy's graph? What does this value tell us about Jimmy's books?

   d) Write an equation for the height of Jimmy's stack after n books.

2. In a different stacking activity, books were removed from a stack and the height was measured and recorded below.

Number of Books Removed	0	1	2	3	4	5	6
Height (cm)	200	196	192	188	184		

   a) Fill in the missing values in the table. Then sketch the graph.

   b) Do the points of this graph lie on a line? If so, does the line rise or fall?

   c) What is the y-intercept of this graph? What does this point tell us about the initial stack?

   d) Each time you remove a book, the height decreases by _____ cm. What does this number represent in your equation? What does this number represent in the context of this problem?

   e) Write an equation for the height of this stack after x books have been removed.

Practice with Building Linear Models

CHECK YOUR UNDERSTANDING

Write your answers on notebook paper. Show your work.

A consultant earns a flat fee of \$75 plus \$50 per hour for a contracted job. The table shows the consultant's earnings.

Hours	0	1	2	3	4
Earnings	\$75	\$125	\$175	\$225	\$275

1. If the consultant has a 36-hour contract, how much will she earn?
2. Write an equation that shows the consultant's earnings E in terms of h, the number of hours of her contract.

Use this table for Items 3 and 4.

x	1	2	3	4	5
y	1	5	9	13	17

3. Write an equation for y in terms of x.
4. Explain how the numbers in your equation relate to the numbers in the table.
5. The equation for the cost C of a cab ride of m miles is $C = 2.5m + 3.5$.
   a. What is the cost of a 6-mile ride?
   b. What is the cost of a 7-mile ride?
   c. How is the price difference between a 6-mile ride and a 7-mile ride related to the numbers in your equation?
6. In the equation $S = 0.25n + 8.5$, S is the height in inches of a stack of jumbo cups and n is the number of cups.
   a. How many cups would it take to make a stack 1 inch higher?
   b. How many cups would fit in a carton that is 18 inches high?
   c. Interpret the slope as a rate of change.
7. MATHEMATICAL REFLECTION What did you learn about creating a linear model? How can you recognize and interpret a constant rate of change?

For #8-10:

a) Write a linear function describing each situation.
b) Identify the quantities representing the domain and range.
c) Answer the question.

8. Travis rented a typewriter for \$15 plus \$1.65 per day. Find the cost if he kept the typewriter for 12 days.

9. Robert earned \$4.50 an hour for painting a garage, plus a bonus of \$10.00. He worked for 6 hours. How much did he earn?

10. A mail-order company sells dried apples for \$4.50 per pound, plus \$2.25 for shipping and handling. How much would five pounds of fruit cost?