THINKING WRITING

10.B Fitting a Line

You will need:

- graph paper
- graphing calculator (optional)

These data are about *average* 45-year-olds.

	Weight (lbs)	
Height	**Men**	**Women**
4′10″		118
5′		123
5′2″	140	129
5′4″	149	136
5′6″	158	143
5′8″	167	150
5′10″	176	158
6′	186	168
6′2″	197	
6′4″	208	

1. On the same axes, graph weight as a function of height for men and women.

The points appear to lie on two straight lines. However by looking at the differences between consecutive entries, you can see that for women, a two-inch difference in height means five more pounds between 4′10″ and 5′, while it means six more pounds between 5′ and 5′2″. This shows that the slope changes, and therefore the points are not lined up exactly.

2. Between what heights is the relationship between height and weight linear? In other words, between what heights do the points lie exactly on a line?

a. Answer this for men and for women.

b. Find the slope of those lines.

c. Find the equations of the lines, in the form $W = mH + b$. (Express heights in inches.)

The equations you found can be used to predict the average weight for 45-year-old men and women *in that range*.

3. Use the equation you found to calculate the weights of a man and a woman who are each 5′5″ tall. Check that your answers are consistent with the data in the table.

4. The unit of height is the inch, the unit of weight is the pound. What is the unit and meaning of the slope in these graphs?

5. In what ranges is the slope less? Greater? Explain why, in terms of the real-world meaning of the data.

It is more difficult to find a linear function relating weight to height if you try to do it over the whole range. Finding such a function is called *fitting a line to the data*. The equation of such a line is useful as an approximate formula.

6. **Exploration** Draw a line that is close to all the data points for the men. Find its equation. (Start out by finding two points on the line you drew and use their coordinates. They do not need to be points from the table.) Do this again for the women. Compare your answers with those of other students.

7. Report Explain how you found a linear equation for these data. Your report should answer the following questions, but not be limited to them.
   - In a paragraph, summarize the information contained in the table.
   - Why is it impossible to find an exact formula relating weight and height?
   - What is the meaning of slope in this context?
   - What does your formula predict for the weight of a 5′ man? Of a 6′2″ woman? Are those predictions probably too high or too low?

DISCOVERY BEYOND SQUARE ROOTS

8. With which of the following numbers of blocks could you build a single cube with no blocks left over? If you could build a cube, give its dimensions. (You may want to use the Lab Gear or make a sketch.)
   a. 8 b. 81
   c. 216 d. 729

Say that we have:

$$64^x \cdot 64^x \cdot 64^x = 64.$$

Using the product of powers law of exponents it is easy to see what x must be:

$$64^{1/3} \cdot 64^{1/3} \cdot 64^{1/3} = 64^1.$$

9. a. What must be the value of $64^{1/3}$? (Hint: What number could you substitute for it in this equation?)
   b. Use the same reasoning to find the value of $27^{1/3}$.

   The 1/3 power of a number is called the cube root of a number. Explain why.

10. Use a law of exponents to simplify.
    a. $64^{2/3}$
    b. $8^{4/3}$
    c. $64^{1/4}$