

Grades 6–9

# ALGEBRA LAB GEAR

## — Basic Algebra —

■ Integer Arithmetic    ■ Equivalent Expressions    ■ Perimeter and Surface Area  
■ The Distributive Property    ■ Equivalent Equations

# BA

By Henri Picciotto

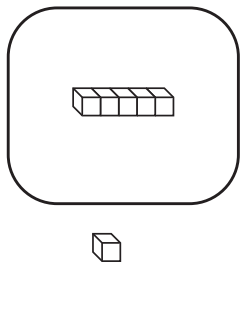


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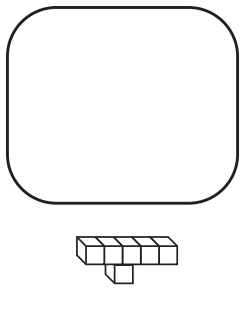
## CHALLENGE 3

### Minus Puzzles

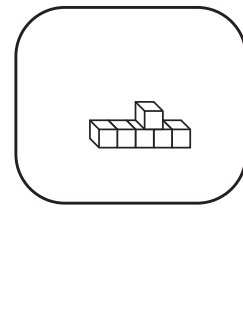
We can use upstairs blocks and the minus area to show a number different ways.



Negative 5, plus 1  
 $-5 + 1 = -4$

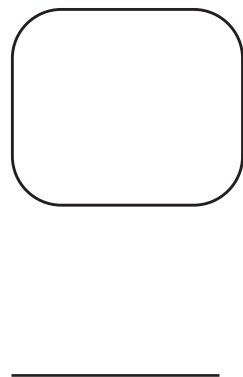
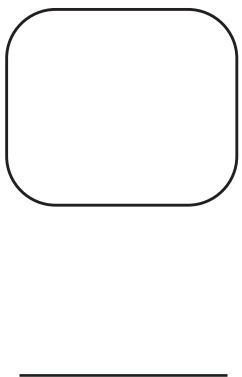
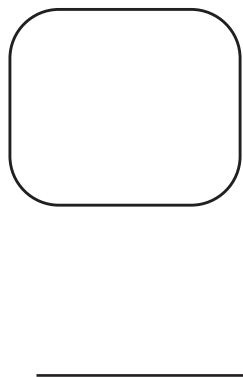
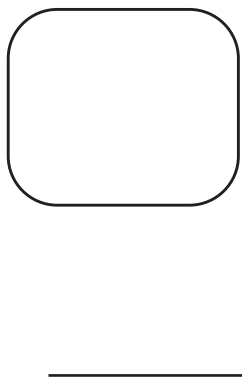


1 minus 5  
 $1 - 5 = -4$

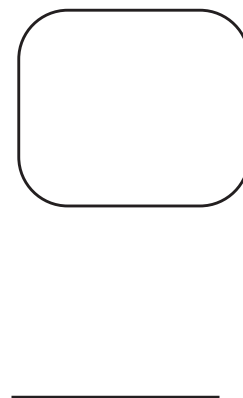
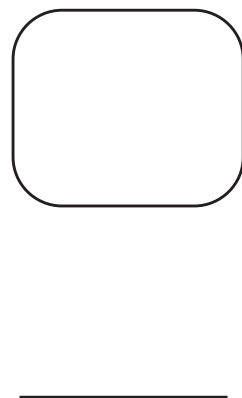
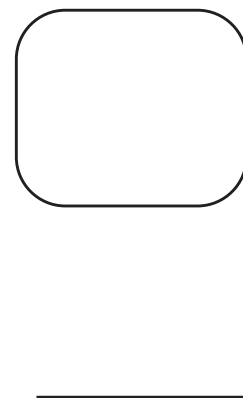
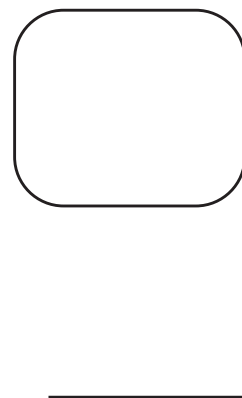


The opposite of 5 minus 1  
 $-(5 - 1) = -4$

1. Find four ways to show 3 with three blocks. Sketch the blocks. Write the equations.



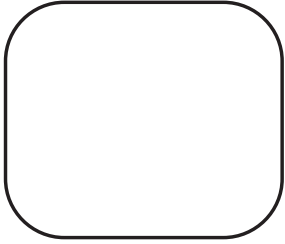
2. Find four ways to show  $-8$  with four blocks. Sketch the blocks. Write the equations.



## CHALLENGE 5

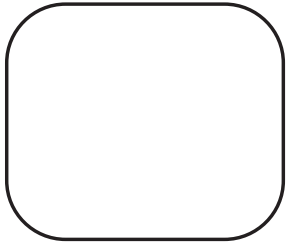
### Minus Puzzles

1. Show  $-9$  with three blocks. Write the equation.



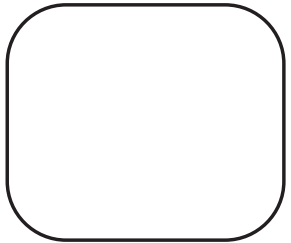
\_\_\_\_\_

2. Show  $-9$  with five blocks. Write the equation.



\_\_\_\_\_

3. Show  $-9$  with seven blocks. Write the equation.



\_\_\_\_\_

4. Make up another set of problems like these.

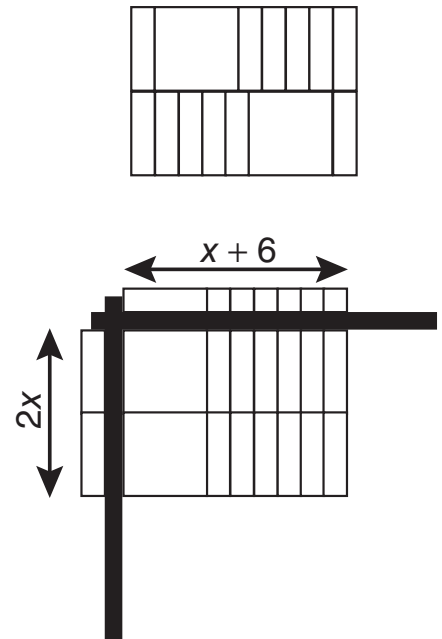
## CHALLENGE 6

### Make a Rectangle

Sometimes a group of blocks can be arranged into a rectangle.

For example, you can rearrange the blocks  $2x^2 + 12x$  into a rectangle like this.

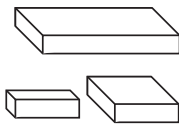
This rectangle has a length of  $x + 6$  and a width of  $2x$ , which can be seen better if you organize the blocks logically and use the corner piece, as shown. (Notice that you could also turn the rectangle so that the length and width are exchanged. This is considered to be the same rectangle.)



For a rectangle, length times width = area. For this rectangle,  $(x + 6) \cdot 2x = 2x^2 + 12x$ .

For each problem, arrange the given blocks into a rectangle. Sketch the rectangle and write the length, width, and area.

1.

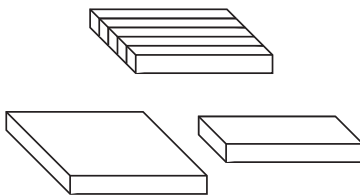


Length \_\_\_\_\_

Width \_\_\_\_\_

Area \_\_\_\_\_

2.

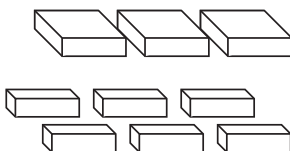


Length \_\_\_\_\_

Width \_\_\_\_\_

Area \_\_\_\_\_

3.



Length \_\_\_\_\_

Width \_\_\_\_\_

Area \_\_\_\_\_

Find another way.

Length \_\_\_\_\_

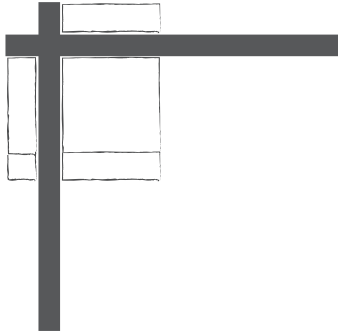
Width \_\_\_\_\_

Area \_\_\_\_\_

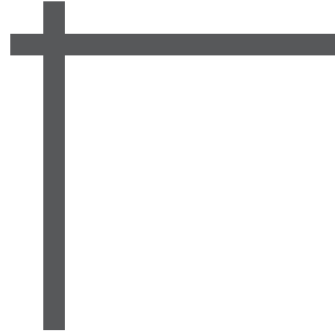
## Multiplication with Variables

Use the corner piece and blocks to show each multiplication. Sketch the blocks. Write the product.

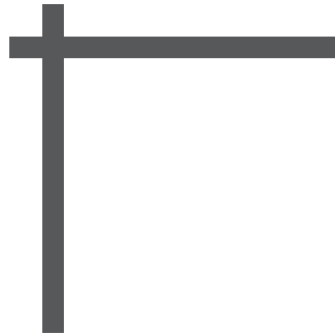
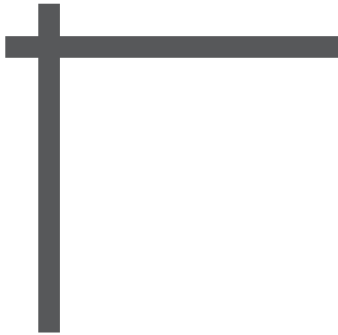
1.  $(x + 1)x = \underline{x^2 + x}$



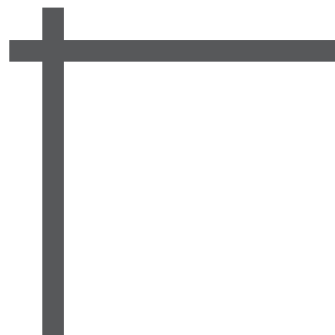
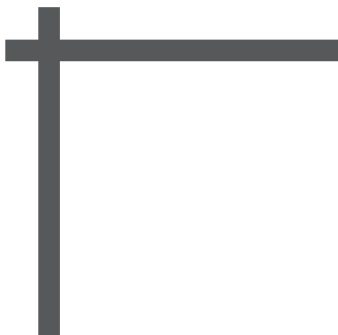
2.  $(x + 2)(x + 3) = \underline{\hspace{2cm}}$

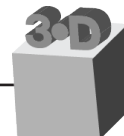


3.  $(x + 5)(x + y) = \underline{\hspace{2cm}}$  4.  $2(y + 1) = \underline{\hspace{2cm}}$



5.  $(y + 4)(y + 1) = \underline{\hspace{2cm}}$  6.  $(2x + 3)(x + y + 1) = \underline{\hspace{2cm}}$

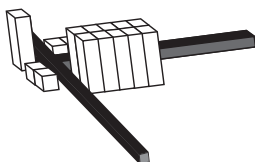
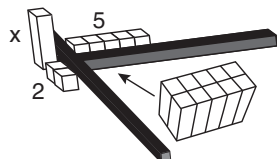




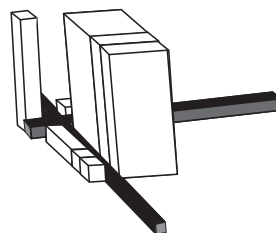
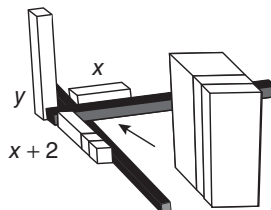
# Make a Box

We can represent the product of two numbers with the *area* of a rectangle. In a similar way, we can represent the product of three numbers with the *volume* of a box:  $length \cdot width \cdot height = volume$ . For example:

$$2 \cdot 5 \cdot x = 10x$$



$$x \cdot (x + 2) \cdot y = x^2y + 2xy$$



Use your corner piece and blocks to show each multiplication. Write the product.

1.  $2 \cdot 5 \cdot 5 =$  \_\_\_\_\_

2.  $2x \cdot y \cdot y =$  \_\_\_\_\_

3.  $(y + 1) \cdot x \cdot y =$  \_\_\_\_\_

4.  $x \cdot (x + 1) \cdot (x + 2) =$  \_\_\_\_\_

5.  $y \cdot y \cdot (y + 1) =$  \_\_\_\_\_

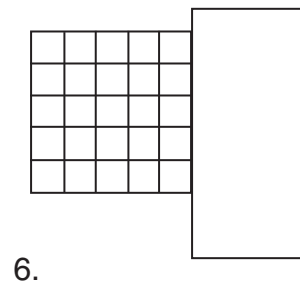
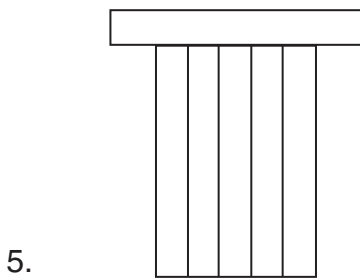
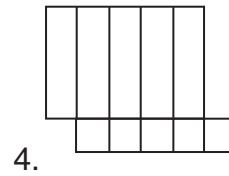
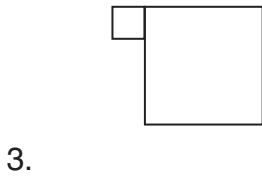
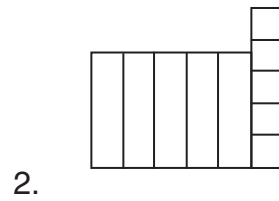
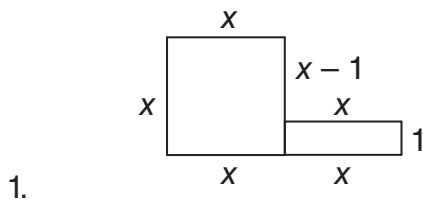
6.  $(x + y) \cdot (x + y) \cdot x =$  \_\_\_\_\_

## CHALLENGE 9

### Perimeter

Even though  $x$  and  $y$  can have any value in other situations, in problems about perimeter, area, and volume, assume that  $x$  and  $y$  are positive. For the problems on this page, assume that  $1 < x < 5$  and  $5 < y < 10$ .

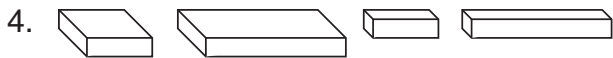
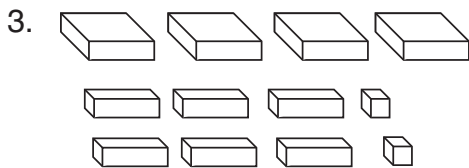
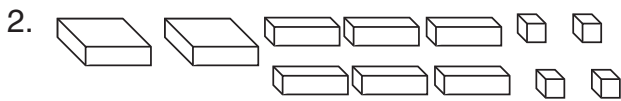
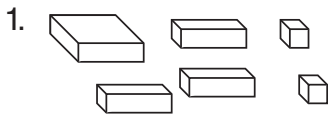
Find and write the perimeter of these figures.



# CHALLENGE 10

## Make a Rectangle

For each problem, arrange the given blocks into a rectangle or square. Sketch it and write a multiplication equation like this: length · width = area.





## More on Minus

Show that these equations are true by adding zero.

1.  $-(y - 2) = -y + 2$



2.  $-(x - 5) = -x + 5$



3.  $-(y - 4) = -y + 4$



4. Complete this sentence: The value of an expression is not changed when upstairs blocks in the minus area are moved \_\_\_\_\_  
\_\_\_\_\_.

# Which Is Greater?

For each problem, show blocks to match and then write the two expressions. Simplify. Write the simplified expressions using  $>$ ,  $<$ , or  $=$ .

1.

\_\_\_\_\_ ? \_\_\_\_\_  
 \_\_\_\_\_ ? \_\_\_\_\_

2.

\_\_\_\_\_ ? \_\_\_\_\_  
 \_\_\_\_\_ ? \_\_\_\_\_

3.

\_\_\_\_\_ ? \_\_\_\_\_  
 \_\_\_\_\_ ? \_\_\_\_\_

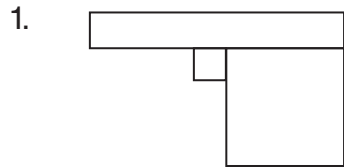
4.

\_\_\_\_\_ ? \_\_\_\_\_  
 \_\_\_\_\_ ? \_\_\_\_\_

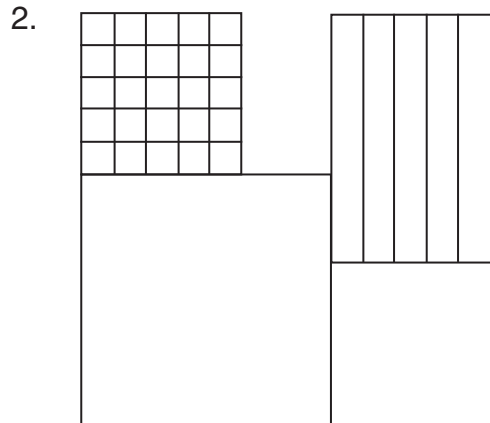
# CHALLENGE 11

## Perimeter

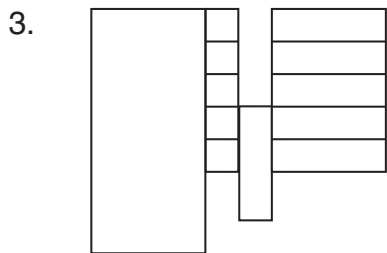
Write the perimeter of each of these figures. For #2, assume the top edges of the top two blocks in the figure line up exactly.



\_\_\_\_\_



\_\_\_\_\_



\_\_\_\_\_

Use an  $xy$ -block and a 5-block to make shapes with these perimeters. Sketch the shape in each case.

4.  $2x + 2y + 2$

5.  $2x + 2y + 10$

6.  $2y + 12$

7. Repeat problems 4–6, using a  $y$ -block and a  $5x$ -block.

8. Use another combination of blocks to get a perimeter of  $2x + 2y + 2$ .

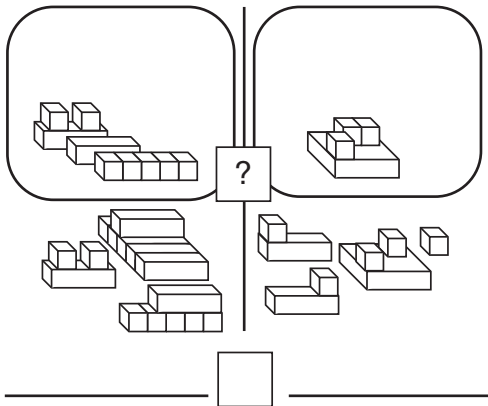
9. Use another combination of blocks to get a perimeter of  $2x + 2y + 10$ .

10. Use another combination of blocks to get a perimeter of  $2y + 12$ .

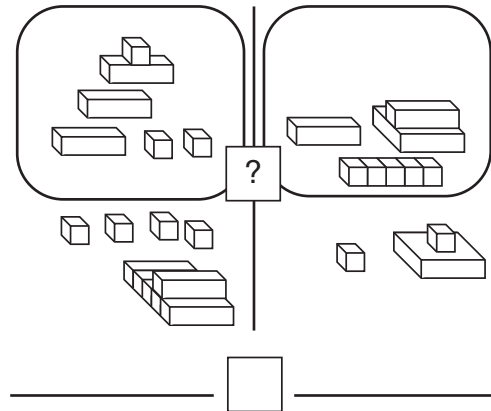
## Which Is Greater?

For each of these problems, show both expressions with your Lab Gear. Simplify by canceling blocks. Decide which side is greater, whether they are equal, or whether it is impossible to tell. Write the simplified statement using =, >, <, or “?”

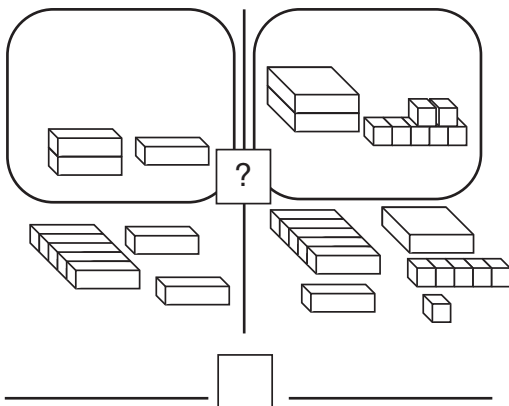
1.



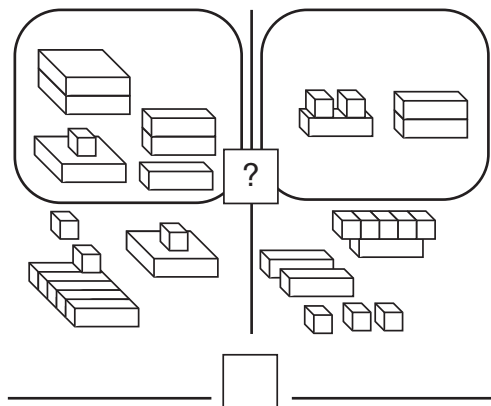
2.



3.



4.

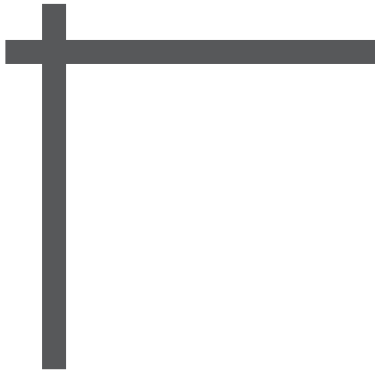


## CHALLENGE 13

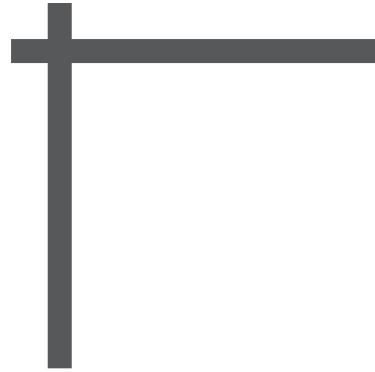
### Make a Rectangle

Take blocks to match each expression. Arrange them into a rectangle inside the corner piece and sketch your blocks. Write a multiplication equation like this:  
*length · width = area.*

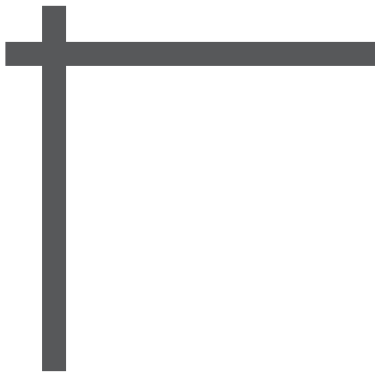
1.  $x^2 + 7x$



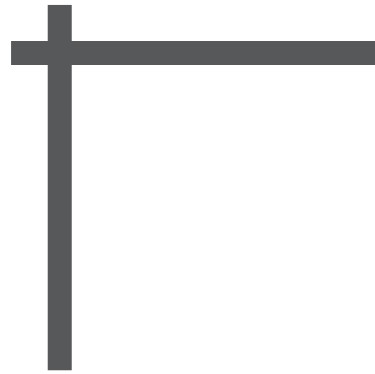
2.  $x^2 + 7x + 6$



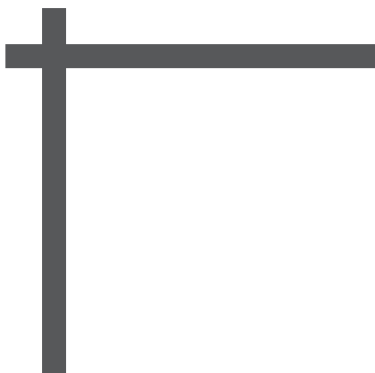
3.  $x^2 + 7x + 10$



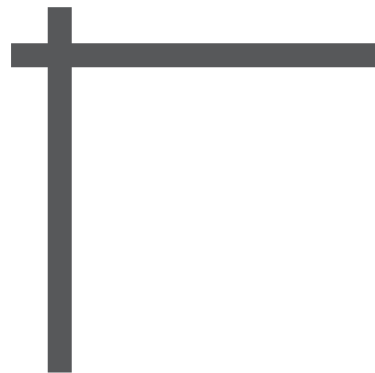
4.  $x^2 + 7x + 12$



5.  $x^2 + 8x + 12$



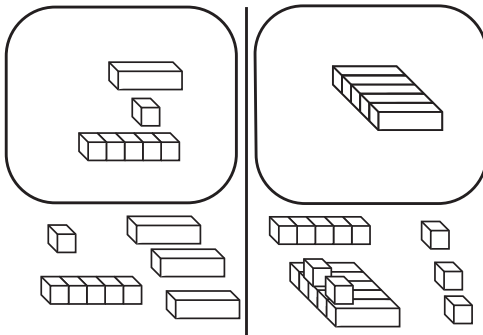
6.  $x^2 + 13x + 12$



# Equations

Use the Lab Gear to solve these equations. Write equations to show some of the steps as you move your blocks.

1.




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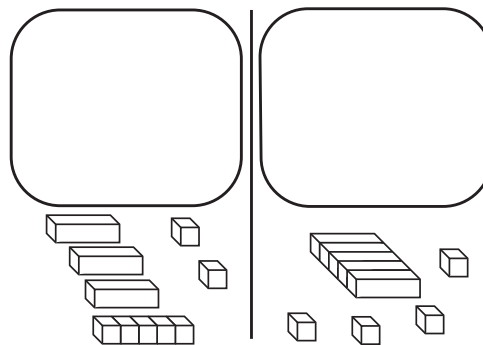


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2.




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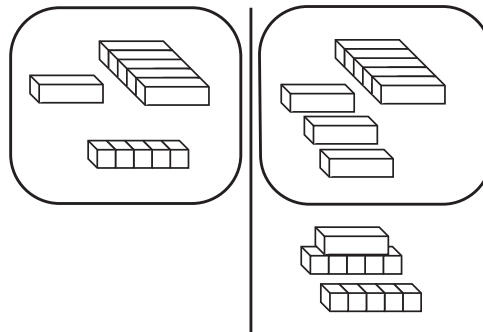


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3.




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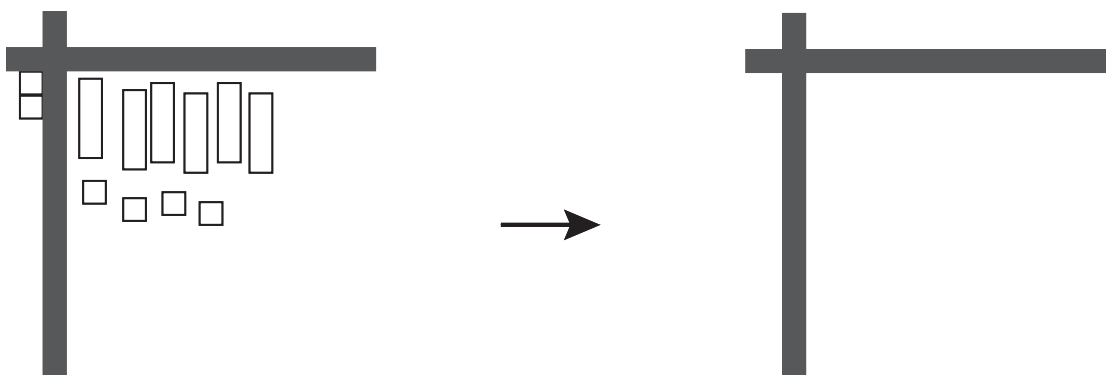


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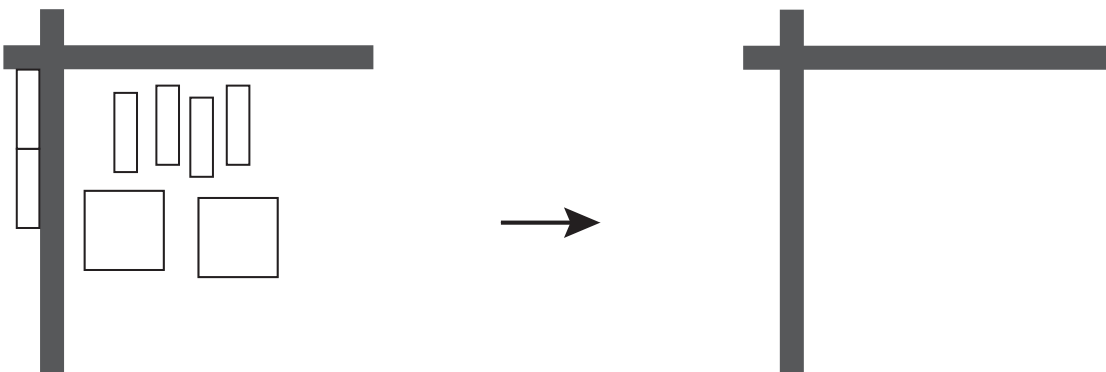
# Division

Use the Lab Gear to represent these divisions. Sketch your blocks. Write the equations.

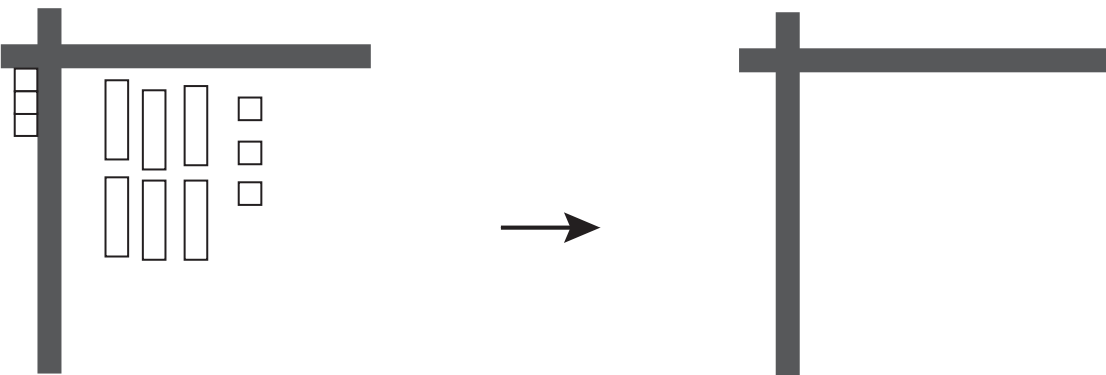
1.



2.



3.

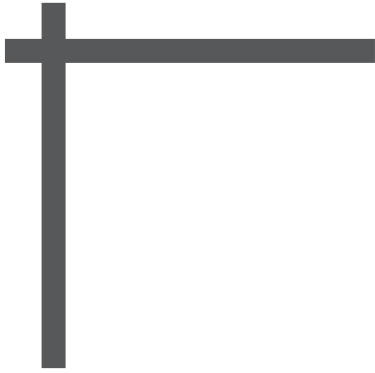


## CHALLENGE 16

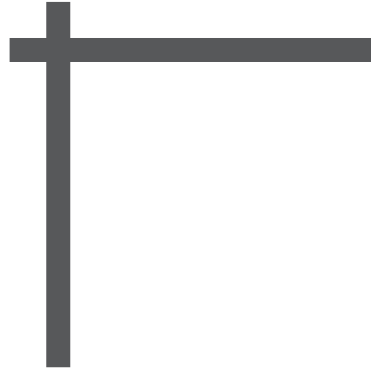
### Make a Square

For each problem, arrange the blocks into a square. Sketch your blocks. Write an equation like this:  $side \cdot side = area$ . *Not all are possible.*

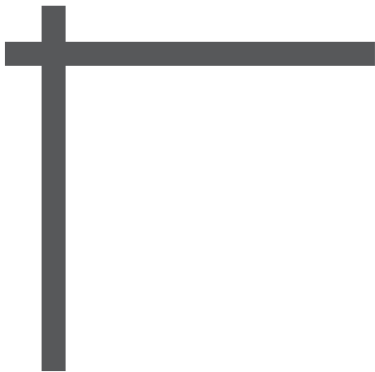
1.  $x^2 + 6x + 9$



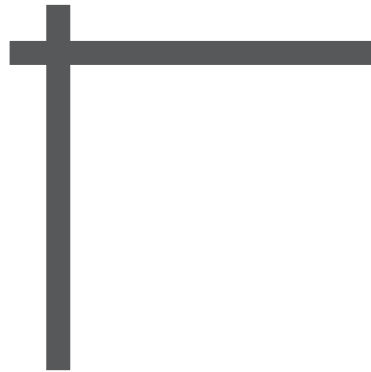
2.  $4x^2 + 4x + 1$



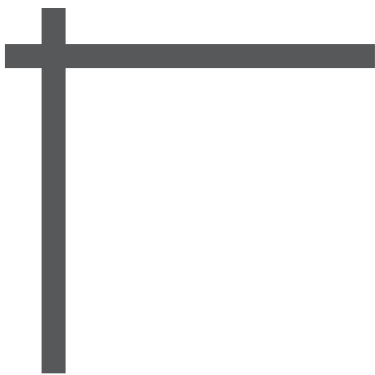
3.  $x^2 + 8x + 4$



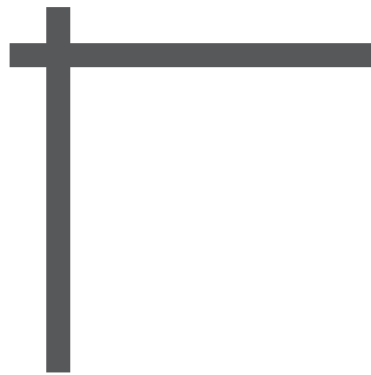
4.  $x^2 + 8x + 16$



5.  $4x^2 + 2x + 4$



6.  $x^2 + 2xy + y^2$

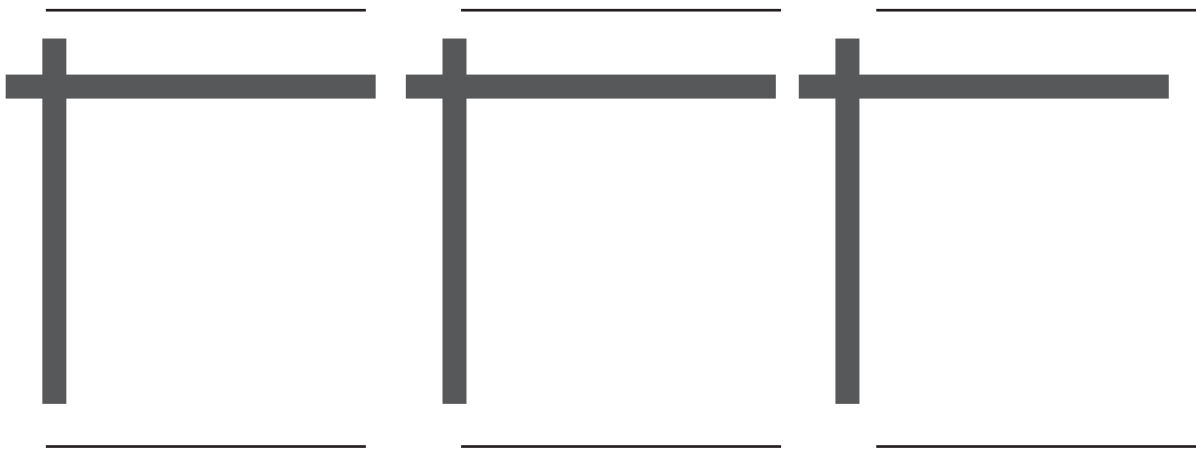
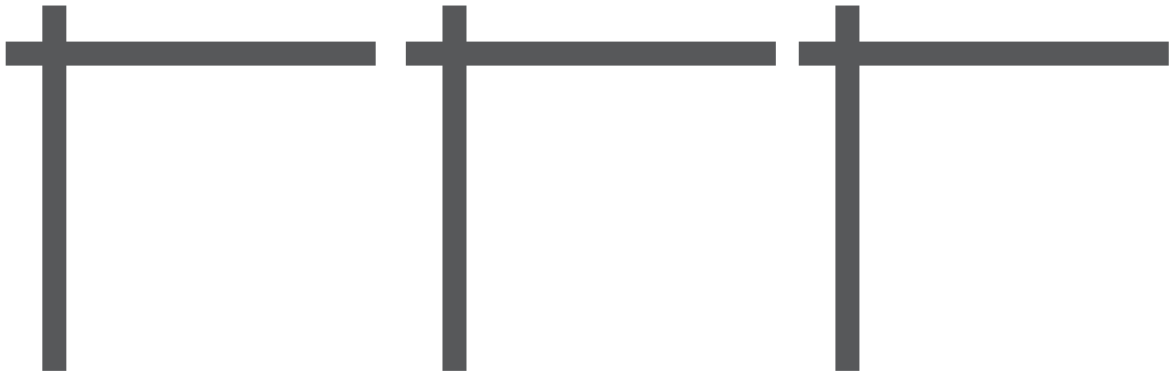




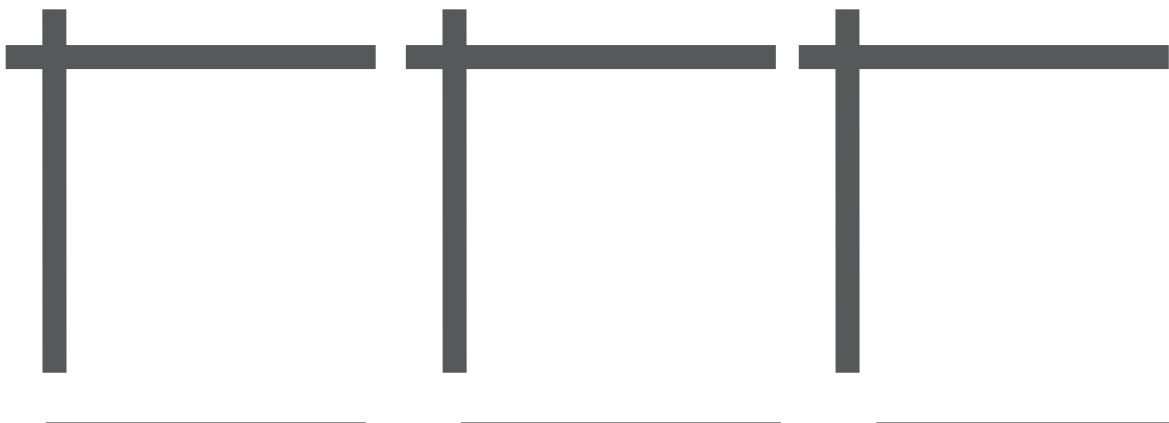
## CHALLENGE 17

### Make a Rectangle

1. Use  $x^2$ ,  $10x$ , and as many yellow blocks as you want. Make six different rectangles. For each one, sketch the blocks and write a multiplication equation to show that *area = length · width*.

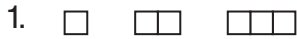


2. Use  $x^2$ ,  $18$ , and as many  $x$ -blocks as you want. Make three different rectangles. For each one, sketch the blocks and write a multiplication equation to show that *area = length · width*.

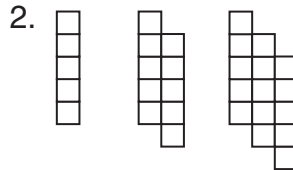


## Perimeter Functions

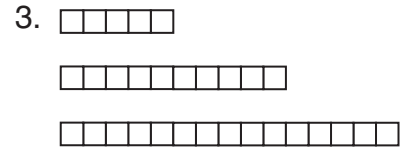
Look at each sequence. Think about how it continues, following the pattern. Write the perimeters of the figures given, then the perimeter of the fourth one, the tenth one, and the hundredth one.



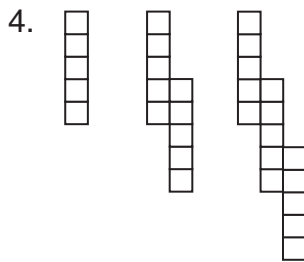
$n$	Perimeter
1	
2	
3	
4	
10	
100	



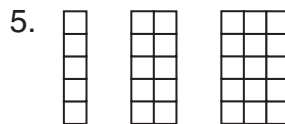
$n$	Perimeter
1	
2	
3	
4	
10	
100	



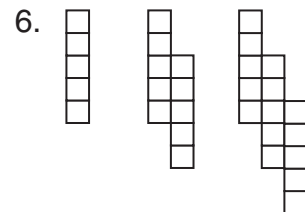
$n$	Perimeter
1	
2	
3	
4	
10	
100	



$n$	Perimeter
1	
2	
3	
4	
10	
100	



$n$	Perimeter
1	
2	
3	
4	
10	
100	



$n$	Perimeter
1	
2	
3	
4	
10	
100	

## CHALLENGE 18

### Make a Square

To make a square with these blocks, add as many yellow blocks as you want, but nothing else. Sketch each square and write an equation like this: *length · width = area*.

1.  $x^2 + 10x +$  (yellow blocks)

2.  $4x^2 + 8x +$  (yellow blocks)

\_\_\_\_\_

3.  $x^2 + 6x +$  (yellow blocks)

\_\_\_\_\_

4.  $x^2 + 2x +$  (yellow blocks)

\_\_\_\_\_

5.  $4x^2 + 12x +$  (yellow blocks)

\_\_\_\_\_