Grades 6–9

ALGEBRA LAB GEAR

Basic Algebra

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

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Contents

Correlation to the Common Core Standards

CCSS Standard	Description	Activities
3.MD.8	Solve real-world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.	Challenge 2
5.NF.4b	Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.	9-1
6.NS.6a	Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite.	3-4, Challenge 3
6.NS.7a	Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram.	11-3, 11-4, 11-5, 13-5
6.EE.1	Write and evaluate numerical expressions involving whole-number exponents.	7-3, 7-4
6.EE.2c	Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).	1-2b, 7-5, 8-1, 8-2, 8-3, 8-4, 12-1, 12-2, 12-3
6.EE.3	Apply the properties of operations to generate equivalent expressions.	13-4
6.EE.5	Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.	2-2, 15-1, 15-2, 15-3, 16-1, 16-2
6.EE.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.	1-2a, 1-3, 2-1
6.EE.7	Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.	14-1, 14-2, 14-3
7.RP.2d	Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.	19-1, 19-2, 19-3
7.NS.1b	Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.	4-1, 4-2, 4-3
7.NS.1c	Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.	5-1, 5-2
7.NS.1d	Apply properties of operations as strategies to add and subtract rational numbers.	5-3

Meet the Lab Gear®

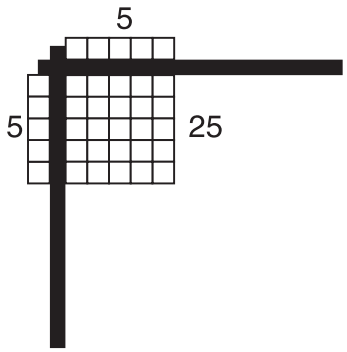
New Words and Concepts

- Variables
- Constants
- Squared

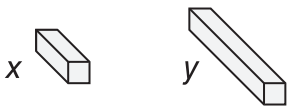
In this lesson, students explore the collections of Lab Gear, organizing the sets into groups of like blocks. This is the first look at the blocks that will be used throughout the program.

Teaching the Idea

1. Give each pair of students a bag of Lab Gear blocks. Say, **Group blocks that are alike together.** (Students should find 14 different kinds of blocks, though there is only one x^3 and one y^3.) If you have an interactive whiteboard or document camera, use it to lead the discussion. (From here on out, the words "on the screen" will be used to refer to this.)
2. Say, **Guess the names for the three yellow blocks.** (If necessary, tell them that the smallest one is called "1." For the other two, mention that counting can help. After they have both been named, show that the "25" could have been figured out by multiplying length and width. Place the block in the corner piece, with a "5" to measure each side, and explain that we have five times five units, or five squared.) This is the first appearance of the area model for multiplication, a key concept in this lesson, and in this book. We will return to it in more depth starting in Challenge 6 and Lesson 9.



3. Say, **This one is *x*, and this one is *y*. One way to remember it is that the letter *x* is short and the letter *y* is long.**



4. **Guess the names for the other blue blocks.** (These are harder to guess. The most likely correct guesses are for $5x$ and $5y$. Tell the students they will soon learn the names of the other ones.)

Discussing the Idea

Tell students that the Lab Gear blocks are used to study algebra. Ask them to make predictions about how the blocks might be used.

Tell students that the only block names they need to memorize are the x and the y. All the other blocks can be figured out by counting, or by measuring them in the corner piece.

It is crucial for subsequent lessons that students are comfortable with multiplication as a way to find the area of a rectangle. They should be able to interpret any rectangle as modeling a multiplication and any multiplication (positive whole numbers) as a rectangle. If this concept is new to your students, provide extra practice. You can use Challenges 1, 6, and 7, and Lesson 9 in this book, as well as Lessons 1.1 and 3.1 in *Algebra Lab Gear: Algebra 1*. You can also easily make up additional problems, or have students make them up.

About the Activities

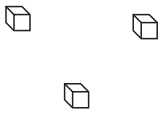
- **Activity 1-1,** The Yellow Blocks, page 4: If this page seems too easy for your students, skip it! (In fact, keep this advice in mind throughout this book.)
- **Activity 1-2a,** The Blue Blocks, page 5: Show the students that five x-blocks are the same as the $5x$-block and that five y-blocks are the same as the $5y$-block. Show them how to use the x- and y-blocks to measure the sides of the rectangles in order to identify the x^2-block, the y^2-block, and the xy-block. Mention that the x^2-block is in fact square.
- **Activity 1-2b,** 3-D Blocks and the Corner Piece, page 6: Explain that these blocks require three measurements: length, width, and height, which is why we call them the 3-D blocks.
- **Activity 1-3,** Make a Quick Sketch of the Lab Gear, page 7: Discourage perfectionism here. The sketches should allow one to recognize the blocks, but they need not be works of art.
- **Challenge 1,** Make a Rectangle, page 11: This is the first of several challenges that require the students to rearrange blocks into a rectangle or square. This time, only yellow blocks are used. If some students prefer working on graph paper to using the blocks, allow them to do that. You may also show how to use the corner piece to measure the sides of the rectangle.

The Yellow Blocks

The yellow blocks are used to show whole numbers. Find these blocks in your Lab Gear.

1 5 25

Use Lab Gear blocks to match these collections. Write the number that is shown by the blocks.

1. 

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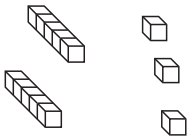
2. 

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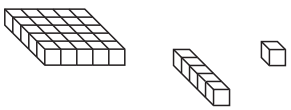
3. 

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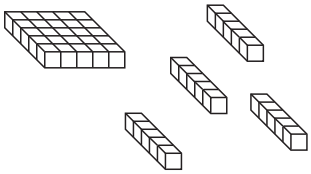
4. 

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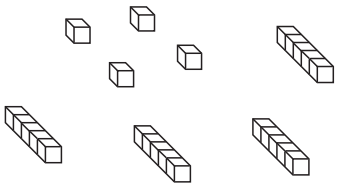
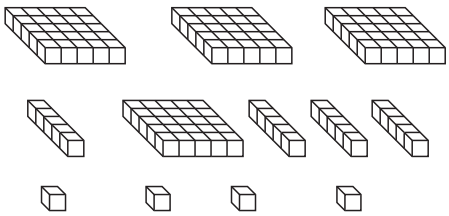
Use your blocks to show these numbers. Circle blocks in the figure to show the blocks you used.

5. 15



6. 51

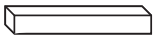


Notice that the 25-block is a 5-by-5 square. In algebra, the multiplication 5 times 5 is written $5 \cdot 5 = 25$, or $5(5) = 25$, or 5^2, pronounced *five squared*. It is not written 5×5, because the $\times$ sign looks like the letter *x*, which is often used in algebra.

The Blue Blocks

The blue blocks are used to show variables. Variables are named by letters. Find these blocks in your Lab Gear.

x



y

1. Write a way to remember which block is *x*, and which is *y*.

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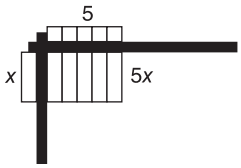
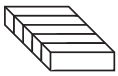
We can tell this is the 5*x* block by counting the *x*'s, or by measuring the sides of the rectangle. Remember that for a rectangle, length times width equals area.



2. Find a block to match each picture. Find the name for each block in the box below. Write the block names on each line.

a. 

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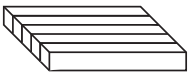
b. 

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c. 

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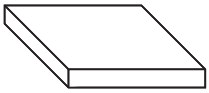
d. 

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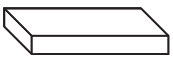
e. 

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5 times *x* (write 5*x*)	5 times *y* (write 5*y*)	*x* times *y* (write *xy*)
x times *x* (write x^2)	*y* times *y* (write y^2)	

3. Explain why x^2 is read "*x* squared."

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3-D Blocks and the Corner Piece

The *volume* of a box is equal to length, times width, times height. For the *xy*-block, the height is 1 cm, so the volume is $x \cdot y \cdot 1 = xy$. This figure shows how to measure length, width, and height in the corner piece:

In a multiplication, we can change the order of the factors, so the volume can be written:

$$x \cdot x \cdot y = x^2y$$

and we say "*x* squared *y*." This is the x^2y block.

1. Find a block to match each picture. Find the name of each block in the box below. Write the block names on each line.

a. 

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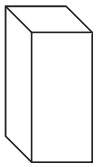
b. 

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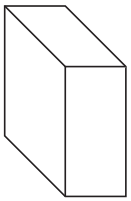
c. 

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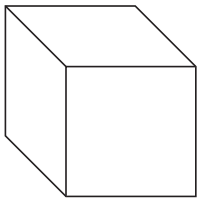
d. 

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x times *x* times *x* (write x^3)	*y* times *y* times *y* (write y^3)
x times *x* times *y* (write x^2y)	*x* times *y* times *y* (write xy^2)

2. Explain why y^3 is read "*y* cubed." _____

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