LESSON 2

Objective

Understand variables and the impact that a change in the value assigned to a variable can have on an algebraic relationship.

Common Core State Standards

- **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). *For example, use the formulas $V = s^3$ and $A = 6\ s^2$ to find the volume and surface area of a cube with sides of length $s = 1/2$.*

Expressions and Equations

Variables x, x^2, and Constants

As students advance through elementary school mathematics, they learn that variables are symbols that vary in value. Variables are usually represented by letters of the alphabet, such as *x* or *y*. Students also should understand that a constant does not vary in value. All numerals are constants, for example. At the middle school level, students must now expand their understanding to include the effect that a change in a variable will have on an algebraic relationship.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *What is the value of* x*? Why is the* x^2 *block commonly called the "x squared" block? What is its length? What is its width? What is its value if* x = 1*? If* x = 2*? If* x = 3*?*
- **Ask:** *How do you know you have correctly represented this expression?*
- **Ask:** *What would the value be if* x = 2*? If* x = 1*?*

Solve It

Reread the problem with students. Have students give another example of an algebraic expression. Ask them to change the value assigned to *x*. Have them write their understanding of how the value of the expression changes.

More Ideas

For other ways to teach about variables and constants—

- Have students set up the XY Coordinate Pegboard for graphing in Quadrants I and II. Have students plot x^2 using the blue pegs and $x^2 + 1$ using the red pegs. They should use positive and negative values for *x*. Discuss the effect the constant has on the graph.
- Have students create an input/output table of values for the equation $y = x^2 + x - 6$. Then have students peg the first few coordinate values on the XY Coordinate Pegboard. Then have students transfer the points to graph paper and continue plotting.
- Have students use Algeblocks to evaluate the expression $x^2 + 3x + 1$, when $x = 3$.

Formative Assessment

Have students try the following problem.

Find the value of the expression when x = 5.

$3x^2 + 4x - 6$

A. 239 **B.** 89 **C.** 54 **D.** 44

Try It! 20 minutes | Pairs

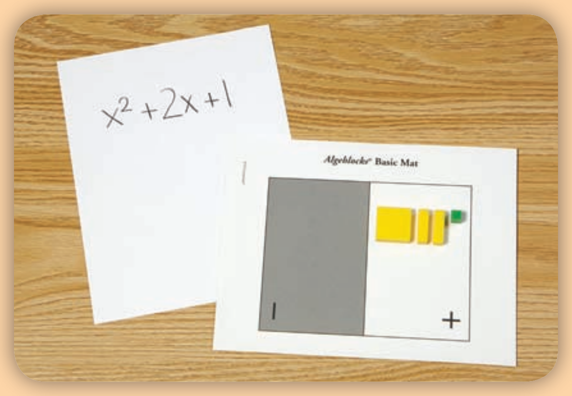
Here is a problem about variables and constants.

Kevin sells intricate glass mosaics at craft shows. He figures the price of each mosaic with the formula $x^2 + 2x + \$1$, where x represents the size of the mosaic in square inches. A customer has $30 to spend. Will the customer have enough money to buy a mosaic that has an area of 4 square inches?

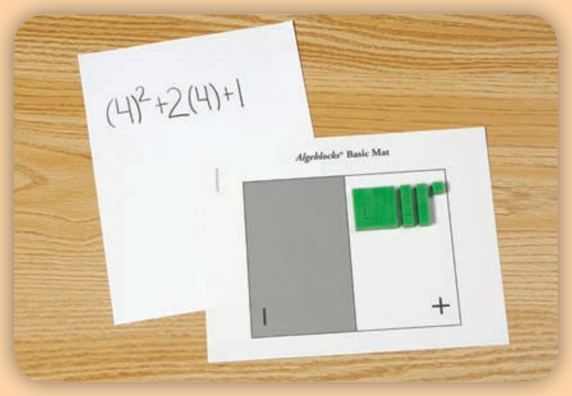
Introduce the problem. Then have students do the activity to solve the problem. Distribute Algeblocks and mats to students.

Materials

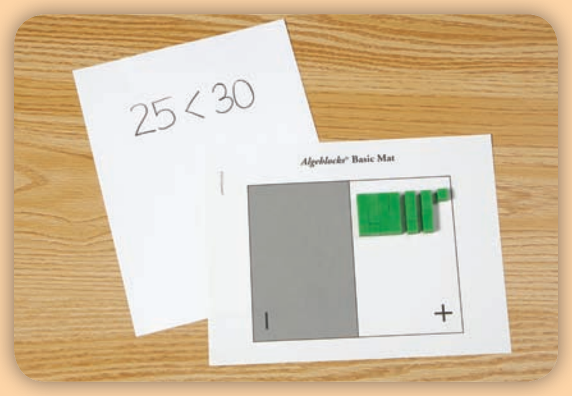
- Algeblocks® (x^2, x, and unit blocks)
- Algeblocks Basic Mat (BLM 6, 1 per pair)



1. Have students lay out the Algeblocks that represent the following algebraic expression: $x^2 + 2x + 1$ on their Basic Mat.



2. Have students exchange each variable for the appropriate value in unit cubes. Students count the unit cubes to determine the value of the expression when $x = 4$.



3. Ask: *How many unit cubes do you have in total? Is the number greater than or less than 30?*

⚠ Look Out!

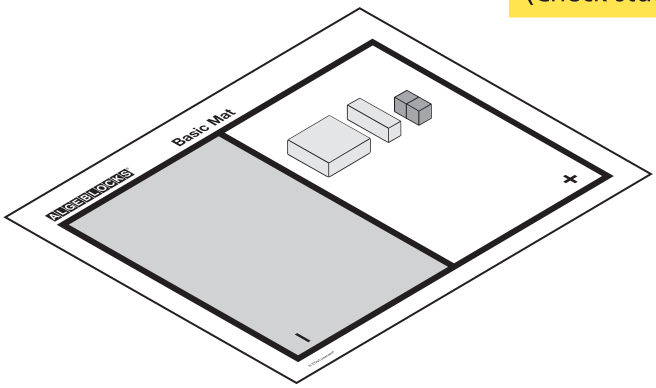
Make sure students do not forget to add the constant value after exchanging their variables for unit cubes. Explain that the constant unit cubes should be identical on both sides of the equation because constants never change value.

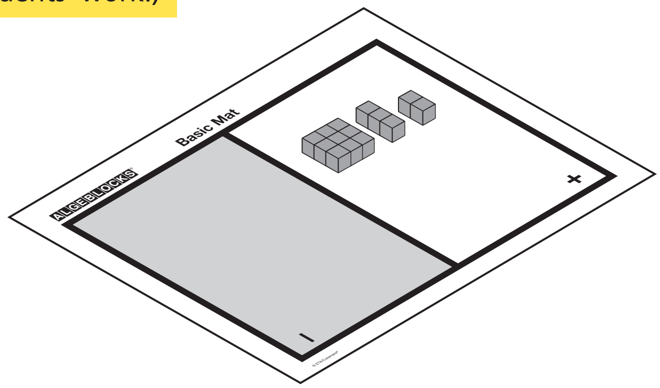
Answer Key

Use Algeblocks and an Algeblocks Basic Mat to model the expression. Evaluate the expression and complete each inequality.

1. $x^2 + x + 2$

(Check students' work.)





When $x = 3$, 14 $<$ 28

When $x = 4$, 22 $>$ 20

Using Algeblocks and an Algeblocks Basic Mat, model each expression and evaluate for the given values of *x*. Sketch the models.

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

When $x = 5$: 40

When $x = 10$: 125

3. $3x^2 + x + 1$

When $x = 1$: 5

When $x = 3$: 31

Evaluate each expression for the given values of *x*.

4. $2x^2 + 4x + 2$, when $x = 1$

8

5. $x^2 + x + 8$, when $x = 4$

28

6. $3x^2 + 2x + 4$, when $x = 2$

20

7. $x^2 + 5x$, when $x = 5$

50

Answer Key

Challenge! When you substitute a value into the expression $3x^2 + x + 11$, in what order do you simplify the operations? Choose a value for x and show the steps you use to find the value of the expression.

Challenge: (Sample) Use the order of operations. Simplify the exponents first, then multiply, and finally add.

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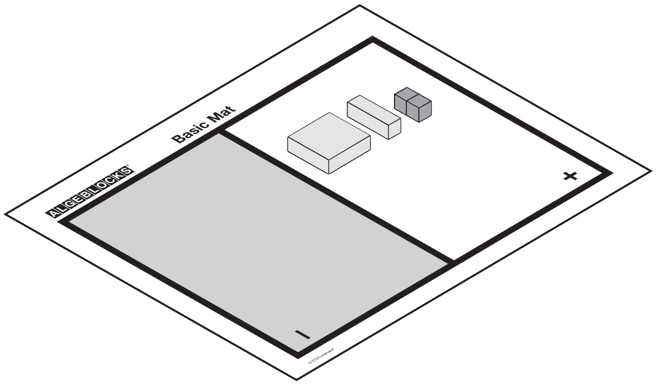
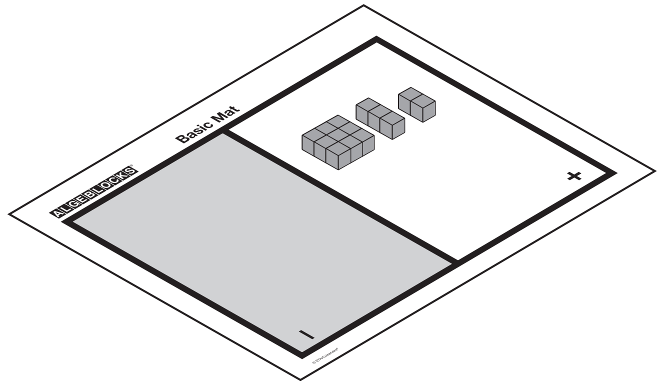
Use Algeblocks and an Algeblocks Basic Mat to model the expression. Evaluate the expression and complete each inequality.

1. $x^2 + x + 2$





When $x = 3$, ________ ◯ 28

When $x = 4$, ________ ◯ 20

Using Algeblocks and an Algeblocks Basic Mat, model each expression and evaluate for the given values of *x*. Sketch the models.

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

When $x = 5$: ______________

When $x = 10$: ______________

3. $3x^2 + x + 1$

When $x = 1$: ______________

When $x = 3$: ______________

Evaluate each expression for the given values of *x*.

4. $2x^2 + 4x + 2$, when $x = 1$

____

5. $x^2 + x + 8$, when $x = 4$

____

6. $3x^2 + 2x + 4$, when $x = 2$

____

7. $x^2 + 5x$, when $x = 5$

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Name ________________________________

Challenge! When you substitute a value into the expression $3x^2 + x + 11$, in what order do you simplify the operations? Choose a value for x and show the steps you use to find the value of the expression.

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