Expressions Summary

KEY TERMS

- power
- base
- exponent
- perfect square
- perfect cube
- evaluate a numeric expression
- Order of Operations
- variable
- algebraic expression
- coefficient
- term
- evaluate an algebraic expression
- like terms
- Distributive Property
- equivalent expressions

LESSON 1 Relationships Matter

Repeated multiplication can be represented as a power. A **power** has two elements: the base and the exponent. The **base** of a power is the factor that is multiplied repeatedly in the power, and the **exponent** of the power is the number of times the base is used as a factor.

$$2 \times 2 \times 2 \times 2 = 2^4$$

$$\underbrace{2^4}_{\text{power}}$$

exponent

base

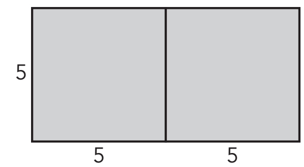
You can read this power in different ways: "2 to the fourth power," "2 raised to the fourth power," or "2 to the fourth."

A number multiplied by itself is a square. The squares of integers are called **perfect squares**. For example, 9 is a perfect square because $3 \times 3 = 9$. Another way to write this equation is $3^2 = 9$. You can read 3^2 as "3 squared."

A number used as a factor three times is a cube. A **perfect cube** is the cube of an integer. For example, 216 is a perfect cube because $6 \times 6 \times 6$, or 6^3, is equal to 216. You can read 6^3 as "6 cubed."

To **evaluate a numeric expression** means to simplify the expression to a single numeric value.

For example, consider the numeric expression $2 \cdot 5^2$ represented by the model shown.



$5^2 = 25$, and $2 \cdot 5^2 = 2 \cdot 25$, or 50.

Therefore, $2 \cdot 5^2$ has a value of 50.

The **Order of Operations** is a set of rules that ensures the same result every time an expression is evaluated.

1. Evaluate expressions inside parentheses or grouping symbols.
2. Evaluate exponents.
3. Multiply and divide from left to right.
4. Add and subtract from left to right.

For example, evaluate the expression $12 \div (4 + 2) + 4^2$ using the Order of Operations.

$12 \div (6) + 4^2$	Evaluate the expression in parentheses.
$12 \div 6 + 16$	Evaluate the exponent.
$2 + 16$	Divide from left to right.
18	Add from left to right.

LESSON 2

Into the Unknown

In mathematics, letters are often used to represent quantities that vary. These letters are called **variables**, and they help you write algebraic expressions to represent situations. An **algebraic expression** is an expression that has at least one variable.

For example, if a school lunch costs $2.25 for each student, you can write an algebraic expression to represent the total amount of money collected for any number of students buying school lunches.

The variable s can represent the unknown number of students buying school lunches. The algebraic expression is $2.25s$.

A number that is multiplied by a variable in an algebraic expression is called the numerical **coefficient**. The coefficient in the expression written above is 2.25.

A **term** of an algebraic expression is a number, variable, or product of numbers and variables.

For example, consider the expression $3x + 4y - 7$. The expression has three terms: $3x$, $4y$, and 7. The operation between the first two terms is addition, and the operation between the second and third term is subtraction. There are two terms with variables and the third term is a constant term of 7.

To **evaluate an algebraic expression** means to determine the value of the expression for a given value of each variable. When you evaluate an algebraic expression, you substitute the given values for the variables, and then determine the value of the expression.

For example, evaluate $10 - \frac{x}{3}$, for $x = 9$.

$10 - \frac{9}{3}$	Substitute the given value for x.
$10 - 3 = 7$	Use the Order of Operations to evaluate the expression.

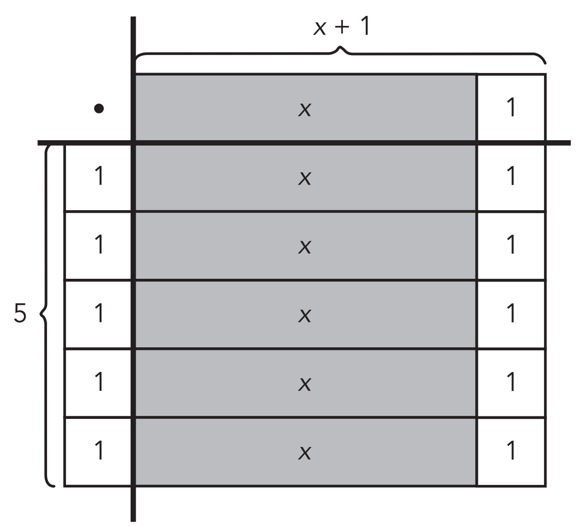
LESSON 3

Second Verse, Same as the First

In an algebraic expression, **like terms** are two or more terms that have the same variable raised to the same power. The numerical coefficients of like terms may be different. You can combine like terms in algebraic expressions by adding or subtracting terms with the same variables. For example, $3x + 5x$ combines to make $8x$.

Algebraic expressions can be rewritten using the **Distributive Property**.

For example, consider the expression $5(x + 1)$, which has two factors: 5 and the quantity $(x + 1)$. In this case, multiply the 5 by each term of the quantity $(x + 1)$. The model using algebra tiles is shown.



$5(x + 1) = 5x + 5$

You can also rewrite an expression of the form $\frac{4x + 8}{4}$ using the Distributive Property.

$$\frac{4x + 8}{4} = \frac{4x}{4} + \frac{8}{4}$$
$$= 1x + 2$$
$$= x + 2$$

The Distributive Property can also be used to rewrite an algebraic expression as a product of two factors: a constant and a sum of terms. This is also referred to as factoring expressions.

To rewrite the expression $4x - 7$ so the coefficient of the variable is 1, factor out the coefficient 4 from each term. The equivalent expression is the product of the coefficient and the sum of the remaining factors.

$$4x - 7 = 4\left(\frac{4x}{4} - \frac{7}{4}\right)$$
$$= 4\left(x - \frac{7}{4}\right)$$

LESSON 4

Are They Saying the Same Thing?

Two algebraic expressions are **equivalent expressions** if, when any values are substituted for the variables, the results are equal.

Creating a table of values, graphing the expressions, or rewriting the expressions using number properties can help you to determine if two expressions are equivalent.

For example, consider the two expressions $3(x + 1) - 2x$ and $x + 3$.

The table of values for each value of x shows that the two expressions are equivalent.

Using the table of values to graph the two expressions results in two lines that lie on top of one another, showing that the expressions are equivalent.

x	$3(x + 1) - 2x$	$x + 3$
0	3	3
1	4	4
2	5	5
3	6	6

You can also rewrite the given expression to show that the two expressions are equivalent.

$3(x + 1) - 2x$	Given
$3x + 3 - 2x$	Distributive Property
$x + 3$	Combine Like Terms

LESSON 5

DVDs and Songs

You can use algebraic expressions to represent, analyze, and solve real-world problems. For example, let k represent the number of books that Karen has.

Jack has three times as many books as Karen: $3k$.

Daniel has 6 more books than Jack: $3k + 6$.

Hannah has twice as many books as Daniel: $2(3k + 6)$.

If Karen has 10 books, determine the total number of books the four friends have together.

Substitute 10 for k in each expression to determine the number of books each friend has.

Jack has $3 \cdot 10$, or 30 books.
Daniel has $3 \cdot 10 + 6$, or 36 books.
Hannah has $2(3 \cdot 10 + 6)$, or 72 books.

The total number of books the four friends have together is $10 + 30 + 36 + 72 = 148$ books.