Parent Packet

HAUPPAUGE MATH DEPARTMENT

CCLS

Grade 6

MODULE 4

http://www.hauppauge.k12.ny.us/math

2014 – 2015 School Year

Grade 6 • Module 4

Expressions and Equations

OVERVIEW

In Module 4, students extend their arithmetic work to include using letters to represent numbers. Students understand that letters are simply "stand-ins" for numbers and that arithmetic is carried out exactly as it is with numbers. Students explore operations in terms of verbal expressions and determine that arithmetic properties hold true with expressions because nothing has changed—they are still doing arithmetic with numbers. Students determine that letters are used to represent specific but unknown numbers and are used to make statements or identities that are true for all numbers or a range of numbers. Students understand the importance of specifying units when defining letters. Students say, "Let K = Karolyn's weight in pounds" instead of "Let K = Karolyn's weight" because weight cannot be a specific number until it is associated with a unit, such as pounds, ounces, grams, etc. They also determine that it is inaccurate to define K as Karolyn because Karolyn is not a number. Students conclude that in word problems, each letter (or variable) represents a number and its meaning is clearly stated.

To begin this module, students are introduced to important identities that will be useful in solving equations and developing proficiency with solving problems algebraically. In Topic A, students understand the relationships of operations and use them to generate equivalent expressions (6.EE.A.3). By this time, students have had ample experience with the four operations since they have worked with them from kindergarten through Grade 5 (1.OA.B.3, 3.OA.B.5). The topic opens with the opportunity to clarify those relationships, providing students with the knowledge to build and evaluate identities that are important for solving equations. In this topic, students discover and work with the following identities: $w - x + x = w$, $w + x - x = w$, $a \div b \cdot b = a$, $a \cdot b \div b = a$ (when $b \neq 0$), and $3x = x + x + x$. Students will also discover that if $12 \div x = 4$, then $12 - x - x - x - x = 0$.

In Topic B, students experience special notations of operations. They determine that $3x = x + x + x$ is not the same as $x3$, which is $x \cdot x \cdot x$. Applying their prior knowledge from Grade 5, where whole number exponents were used to express powers of ten (5.NBT.A.2), students examine exponents and carry out the order of operations, including exponents. Students demonstrate the meaning of exponents to write and evaluate numerical expressions with whole number exponents (6.EE.A.1).Students represent letters with numbers and numbers with letters in Topic C. In past grades, students discovered properties of operations through example (1.OA.B.3, 3.OA.B.5). Now, they use letters to represent numbers in order to write the properties precisely. Students realize that nothing has changed because the properties still remain statements about numbers. They are not properties of letters, nor are they new rules introduced for the first time. Now, students can extend arithmetic properties from manipulating numbers to manipulating expressions. In particular, they develop the following identities: $a \cdot b = b \cdot a$, $a + b = b + a$, $g \cdot 1 = g$, $g + 0 = g$, $g \div 1 = g$, $g \div g = 1$, and $1 \div g = 1\ g$.

Students understand that a letter in an expression represents a number. When that number replaces that letter, the expression can be evaluated to one number. Similarly, they understand that a letter in an expression can represent a number. When that number is replaced by a letter, an expression is stated (6.EE.A.2).

In Topic D, students become comfortable with new notations of multiplication and division and recognize their equivalence to the familiar notations of the prior grades. The expression $2 \times b$ is exactly the same as $2 \cdot b$ and both are exactly the same as $2b$. Similarly, $6 \div 2$ is exactly the same as 62. These new conventions are practiced to automaticity, both with and without variables. Students extend their knowledge of GCF and the distributive property from Module 2 to expand, factor, and distribute expressions using new notation (6.NS.B.4). In particular, students are introduced to factoring and distributing as algebraic identities. These include: $a + a = 2 \cdot a = 2a$, $(a + b) + (a + b) = 2 \cdot (a + b) = 2(a + b) = 2a + 2b$, and $a \div b = ab$.

In Topic E, students express operations in algebraic form. They read and write expressions in which letters stand for and represent numbers (6.EE.A.2). They also learn to use the correct terminology for operation symbols when reading expressions. Similarly, students write algebraic expressions that record operations with numbers and letters that stand for numbers. Students determine that $3a + b$ can represent the story "Martina tripled her money and added it to her sister's money" (6.EE.A.2b).

A Mid-Module Assessment follows Topic E. Students write and evaluate expressions and formulas in Topic F. They use variables to write expressions and evaluate those expressions when given the value of the variable (6.EE.A.2). From there, students create formulas by setting expressions equal to another variable. For example, if there are 4 bags containing c colored cubes in each bag with 3 additional cubes, students use this information to express the total number of cubes as $4c + 3$. From this expression, students develop the formula $t = 4c + 3$, where t is the total number of cubes. Once provided with a value for the amount of cubes in each bag ($c = 12$ cubes), students can evaluate the formula for t: $t = 4(12) + 3$, $t = 48 + 3$, $t = 51$. Students continue to evaluate given formulas such as the volume of a cube, $V = s3$ given the side length, or the volume of a rectangular prism, $V = l \cdot w \cdot h$ given those dimensions (6.EE.A.2c).

In Topic G, students are introduced to the fact that equations have a structure similar to some grammatical sentences. Some sentences are true: "George Washington was the first president of the United States." Or "2 + 3 = 5." Some are clearly false: "Benjamin Franklin was a president of the United States." or "7 + 3 =5." Sentences that are always true or always false are called closed sentences. Some sentences need additional information to determine whether they are true or false. The sentence "She is 42 years old" can be true or false depending on who "she" is. Similarly, the sentence "$x + 3 = 5$" can be true or false depending on the value of x. Such sentences are called open sentences. An equation with one or more variables is an open sentence. The beauty of an open sentence with one variable is that if the variable is replaced with a number, then the new sentence is no longer open: it is either clearly true or clearly false. For example, for the open sentence $x + 3 = 5$: If x is replaced by 7, the new closed sentence, $7 + 3 = 5$, is false because $10 \neq 5$. If x is replaced by 2, the new closed sentence, $2 + 3 = 5$, is true because $5 = 5$.

From here, students conclude that solving an equation is the process of determining the number(s) that, when substituted for the variable, result in a true sentence (6.EE.B.5). In the previous example, the solution for $x + 3 = 5$ is obviously 2. The extensive use of bar diagrams in Grades K–5 makes solving equations in Topic G a fun and exciting adventure for students. Students solve many equations twice, once with a bar diagram and once using algebra. They use identities and properties of equality that were introduced earlier in the module to solve one-step, two-step, and multistep equations. Students solve problems finding the measurements of missing angles represented by letters (4.MD.C.7) using what they learned in Grade 4 about the four operations and what they now know about equations.

In Topic H, students use their prior knowledge from Module 1 to construct tables of independent and dependent values in order to analyze equations with two variables from real-life contexts. They represent equations by plotting the values from the table on a coordinate grid (5.G.A.1, 5.G.A.2, 6.RP.A.3a, 6.RP.A.3b, 6.EE.C.9). The module concludes with students referring to true and false number sentences in order to move from solving equations to writing inequalities that represent a constraint or condition in real-life or mathematical problems (6.EE.B.5, 6.EE.B.8). Students understand that inequalities have infinitely many solutions and represent those solutions on number line diagrams.

Grade 6 Module 4

Expressions and Equations

In Module 4, Expressions and Equations, students extend their arithmetic work to include using letters to represent numbers in order to understand that letters are simply "stand-ins" for numbers and that arithmetic is carried out exactly as it is with numbers. Students explore operations in terms of verbal expressions and determine that arithmetic properties hold true with expressions because nothing has changed—they are still doing arithmetic with numbers. Students determine that letters are used to represent specific but unknown numbers and are used to make statements or identities that are true for all numbers or a range of numbers. They understand the relationships of operations and use them to generate equivalent expressions, ultimately extending arithmetic properties from manipulating numbers to manipulating expressions. Students read, write and evaluate expressions in order to develop and evaluate formulas. From there, they move to the study of true and false number sentences, where students conclude that solving an equation is the process of determining the number(s) that, when substituted for the variable, result in a true sentence. They conclude the module using arithmetic properties, identities, bar models, and finally algebra to solve one-step, two-step, and multi-step equations.

Topic A

Relationships of the Operations

In Topic A, students further discover and clarify the relationships of the operations using models. From these models, students build and evaluate identities that are useful in solving equations and developing proficiency with solving problems algebraically.

To begin, students will use models to discover the relationship between addition and subtraction. In Lesson 1, for example, a model could represent the number three. Students notice that if two are taken away, there is a remainder of one. However, when the students replace the two units, they notice the answer is back to the original three. Hence, students first discover the identity $w - x + x = w$ and later discover that $w + x - x = w$.

In Lesson 2, students also model the relationship between multiplication and division. They note that when they divide eight units into two equal groups, they find a quotient of four. They discover that if they multiply that quotient by the number of groups, then they return to their original number, eight, and ultimately build the identities $a \div b \cdot b = a$ and $a \cdot b \div b = a$, when $b \neq a$.

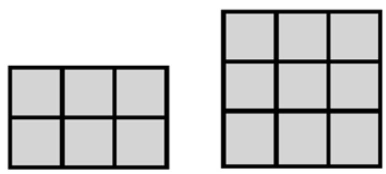
Students continue to discover identities in Lesson 3, where they determine the relationship between multiplication and addition. Using tape diagrams from previous modules, students are assigned a diagram with three equal parts, where one part is assigned a value of four. They note that since there are three equal parts, they can add four three times to determine the total amount. They relate to multiplication and note that three groups with four items in each group produces a product of twelve, determining that
$3 \cdot g = g + g + g$.

Finally in Lesson 4, students relate division to subtraction. They notice that dividing eight by two produces a quotient of four. They experiment and find that if they subtract the divisor from the dividend four times (the quotient), they will find a remainder of zero. They continue to investigate with other examples and prove that if they continually subtract the divisor from the dividend, they will determine a difference, or remainder, of zero. Hence, $12 \div x = 4$ means $12 - x - x - x - x = 0$.

Topic B

Special Notations of Operations

In Topic B, students differentiate between the product of two numbers and whole numbers with exponents. They differentiate between the two through exploration of patterns, specifically noting how squares grow from a 1×1 measure. They determine that a square with a length and width of three units in measure is constructed with nine square units. This expression is represented as 3^2 and is evaluated as the product of $3 \times 3 = 9$, not the product of the base and exponent, 6. They further differentiate between the two by comparing the areas of two models with similar measures, as shown below:



$2a$
When $a = 3$ the area of the rectangle is 6 square units.

a^2
When $a = 3$ the area of the rectangle is 9 square units.

Once students understand that the base is multiplied by itself the number of times as stated by the exponent, they make a smooth transition into bases that are represented with positive fractions and decimals. They know that for any number, a, we define a^m to be the product of m factors of a. The number a is the base and m is called the exponent (or the power) of a.

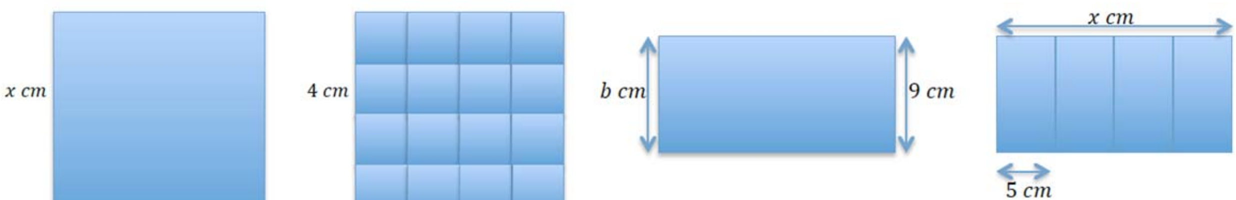
In Lesson 6, students build on their previous understanding of the order of operations by including work with exponents. They follow the order of operations to evaluate numerical expressions. They recognize in the absence of parentheses that exponents are evaluated first. Students identify when the order of operations is incorrectly applied and determine the applicable course to correctly evaluate expressions. They understand that the placement of parentheses can alter the final solution when evaluating expressions, as in the following example:

$2^4 \cdot (2 + 8) - 16$	$2^4 \cdot 2 + 8 - 16$
$2^4 \cdot 10 - 16$	$16 \cdot 2 + 8 - 16$
$16 \cdot 10 - 16$	$32 + 8 - 16$
$160 - 16$	$40 - 16$
144	24

Topic C

Replacing Letters and Numbers

Students begin substituting, or replacing, letters with numbers and numbers with letters in Topic C in order to evaluate expressions with a given number and to determine expressions to create identities. In Lesson 7, students replace letters with a given number in order to evaluate the expression to one number. They continue to practice with exponents in this lesson in order to determine the area of squares and rectangles as shown below.



$A = l \cdot w$
$A = x\ cm \cdot x\ cm$
$A = x^2 cm^2$

$A = l \cdot w$
$A = 4\ cm \cdot 4\ cm$
$A = 4^2 cm^2$
$A = 16\ cm^2$

$Width = 9\ cm$
$Width = b\ cm$
$b = 9cm$

$Length = x\ cm$
$Length = 4 \cdot 5\ cm$
$Length = 20\ cm$
$x = 20\ cm$

$A = l \cdot w$
$A = x \cdot b$
$A = 20\ cm \cdot 9\ cm$
$A = 180\ cm^2$

In Lesson 8, students understand that a number in an expression can be replaced with a letter to determine identities. Through replacement of numbers, students discover and build identities. These identities will aid in solving equations with variables, as well as problem solving with equations.

$4 \times 1 = 4$
$4 \div 1 = 4$
$4 \times 0 = 4$
$1 \div 4 = \frac{1}{4}$

→

$g \times 1 = g$
$g \div 1 = g$
$g \times 0 = 0$
$1 \div g = \frac{1}{g}$

$3 + 4 = 4 + 3$
$3 \times 4 = 4 \times 3$
$3 + 3 + 3 + 3 = 4 \times 3$
$3 \div 4 = \frac{3}{4}$

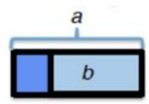
→

$a + 4 = 4 + a$
$a \times 4 = 4 \times a$
$a + a + a + a = 4 \times a$
$a \div 4 = \frac{a}{4}$

Topic D

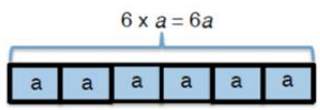
Expanding, Factoring, and Distributing Expressions

In Topic D, students formally utilize their understanding of expressions in order to expand, factor, and distribute. In Lesson 9, students write expressions that record addition and subtraction operations with numbers through the use of models. With a bar diagram, students understand that any number a plus any number b is the same as adding the numbers $b + a$. Students also use bar diagrams to differentiate between the mathematical terms "subtract" and "subtract from." For instance, when subtracting b from a, they know they must first represent a in order to take away b, leading to an understanding that the expression must be written $a - b$.

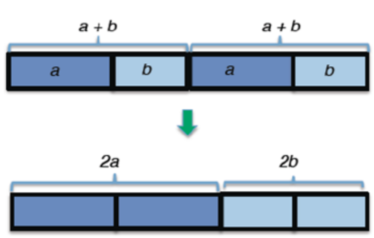


This concept deters students from writing the incorrect expression $b - a$, which is a common misconception because the number b is heard first in the expression "subtract b from a." Students continue to write expressions by combining operations with the use of parentheses.

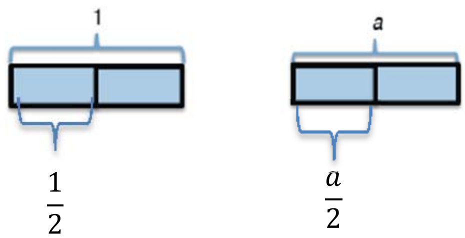
In Lesson 10, students identify parts of an expression using mathematical terms for multiplication. They view one or more parts of an expression as a single entity. They determine that through the use of models, when a is represented 6 times, the expression is written as one entity: $6 \times a$, $6 \cdot a$, or $6a$.



In Lesson 11, students bring with them their previous knowledge of GCF and the distributive property from Module 2 to model and write expressions using the distributive property. They move from a factored form to an expanded form of an expression, while in Lesson 12, they move from an expanded form to a factored form. In Lesson 11, students are capable of moving from the expression $2a + 2b$ to $a + b$ written twice as $(a + b) + (a + b)$ and conclude that $2a + 2b = 2(a + b)$. Conversely, students determine in lesson twelve that $(a + b) + (a + b) = 2a + 2b$ through the following model:



Finally, in Lessons 13 and 14, students write division expressions in two forms: $dividend \div divisor$ and $\frac{dividend}{divisor}$, noting the relationship between the two. They determine from the model below that $1 \div 2$ is the same as $\frac{1}{2}$. They make an intuitive connection to expressions with letters and also determine that $a \div 2$ is the same as $\frac{a}{2}$.



Topic E

Expressing Operations in Algebraic Form

In Topic E, students express mathematical terms in algebraic form. They read and write expressions in which letters stand for numbers. In Lesson 15, students provide word descriptions for operations in an algebraic expression. Given the expression $4b + c$, student assign the operation term "product" for multiplication and the term "sum" for addition. They verbalize the expression as "the sum of c and the product of 4 and b." However, in Lessons 16 and 17 students are given verbal expressions, and they write algebraic expressions to record operations with numbers and letters standing for numbers. Provided the verbal expression, "Devin quadrupled his money and deposited it with his mother's," students write the expression $4a + b$, where a represents the amount of money Devin originally had and b represents the amount of money his mother has. Or, provided the verbal expression, "Crayons and markers were put together and distributed equally to six tables," students create the algebraic expression $\frac{(a+b)}{6}$, where a represents the number of crayons and b represents the number of markers. Mastery of reading and writing expressions in this topic will lead to a fluent transition in the next topic where students will read, write, and evaluate expressions.

Topic F

Writing and Evaluating Expressions and Formulas

In Topic F, students demonstrate their knowledge of expressions from previous topics in order to write and evaluate expressions and formulas. Students bridge their understanding of reading and writing expressions to substituting values in order to evaluate expressions. They evaluate those expressions when they are given the value of the variable. For example, given the problem "Quentin has two more dollars than his sister, Juanita," students determine the variable to represent the unknown. In this case, students let $x =$ Juanita's money, in dollars. Since Quentin has two more dollars than Juanita, students represent his quantity as $x + 2$. Now, students can substitute given values for the variable to determine the amount of money Quentin and Juanita have. If Juanita has fourteen dollars, students substitute the x with the amount, 14, and evaluate the expression: $x + 2$

$$14 + 2$$

$$16$$

Here, students determine that the amount of money Quentin has is 16 dollars because 16 is two more than the 14 dollars Juanita has.

In Lesson 19, students develop expressions involving addition and subtraction from real-world problems. They use tables to organize the information provided and evaluate expressions for given values. They continue to Lesson 20 where they develop expressions again, this time focusing on multiplication and division from real-world problems. Students bridge their study of the relationships between operations from Topic A to further develop and evaluate expressions in Lesson 21, focusing on multiplication and addition in real-world contexts.

Building from their previous experiences in this topic, students create formulas in Lesson 22 by setting expressions equal to another variable. Students assume, for example, that there are p peanuts in a bag. There are three bags and four extra peanuts all together. Students express the total number of peanuts in terms of p: $3p + 4$. Students let t be the total number of peanuts and determine a formula that expresses the relationship between the number of peanuts in a bag and the total number of peanuts, $t = 3p + 4$. From there, students are provided a value for p, which they substitute into the formula: if $p = 10$, they determine that $3(10) + 4 = 30 + 4 = 34$ peanuts.

Topic G

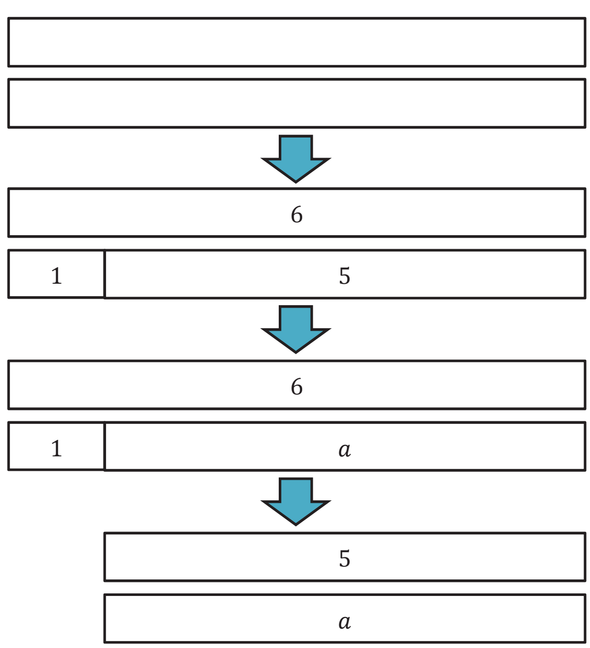
Solving Equations

In Topic G, students move from identifying true and false number sentences to making true number sentences false and false number sentences true. In Lesson 23, students explain what equality and inequality symbols represent. They determine if a number sentence is true or false based on the equality or inequality symbol.

Symbol	Meaning	Example
$=$	Is equal to	$1.8 + 3 = 4.8$
$\neq$	Is not equal to	$6 \div \frac{1}{2} \neq 3$
$>$	Is greater than	$1 > 0.9$
$<$	Is less than	$\frac{1}{4} < \frac{1}{2}$

In Lesson 24, students move to identifying a value or a set of values that make number sentences true. They identify values that make a true sentence false. For example, students substitute 4 for the variable in $x + 12 = 14$ to determine if the sentence is true or false. They note that when 4 is substituted for x, the sum of $x + 12$ is 16, which makes the sentence false because $16 \neq 14$. They bridge this discovery to Lesson 25 where students understand that the solution of an equation is the value or values of the variable that makes the equation true.

Students begin solving equations in Lesson 26. They use bar models or tape diagrams to depict an equation and apply previously learned properties of equality for addition and subtraction to solve the equation. Given the equation$1 + a = 6$, students represent the equation with the following model:



Students recognize that the solution can also be found using properties of operations. They make connections to the model and determine that $1 + a - 1 = 6 - 1$ and, ultimately, that $a = 5$. Students represent two step and multi-step equations involving all operations with bar models or tape diagrams while continuing to apply properties of operations and the order of operations to solve equations in the remaining lessons in this topic.

Topic H

Applications of Equations

In Topic H, students apply their knowledge from the entire module to solve equations in real-world, contextual problems. In Lesson 30, students use prior knowledge from Grade 4 to solve missing angle problems. Students write and solve one step equations in order to determine a missing angle. Lesson 31 involves students using their prior knowledge from Module 1 to contruct tables of independent and dependent values in order to analyze equations with two variables from real-life contexts. They represent equations by plotting values from the tables on a coordinate grid in Lesson 32. The module concludes with Lessons 33 and 34, where students refer to true and false number sentences in order to move from solving equations to writing inequalities that represent a constraint or condition in real-life or mathematical problems. Students understand that inequalities have infinitely many solutions and represent those solutions on number line diagrams.

Terminology

New or Recently Introduced Terms

- **Simple Expression** (A *simple expression* is a number, a letter which represents a number, a product whose factors are either numbers or letters involving whole number exponents, or sums and/or differences of such products. Each product in a simple expression is called a *term*, and the evaluation of the numbers in the product is called the *coefficient of the term.*)
- **Linear Expression** (A *linear expression* is a product of two simple expressions where only one of the simple expressions has letters and only one letter in each term of that expression or sums and/or differences of such products.)
- **Equivalent Expressions** (Two simple expressions are *equivalent* if both evaluate to the same number for every substitution of numbers into all the letters in both expressions.) [Note: This description is not very precise—this needs to be described using lots of examples.]
- **Equation** (An *equation* is a statement of equality between two expressions.)
- **Truth Values of a Number Sentence** (A number sentence is said to be *true* if both numerical expressions are equivalent; it is said to be *false* otherwise. *True* and *false* are called *truth values.*)
- **Exponential Notation for Whole Number Exponents** (Let m be a non-zero whole number. For any number a, we define a^m to be the product of m factors of a, i.e., $a^m = \underbrace{a \cdot a \cdot a \cdot a \ldots \cdot a}_{m \text{ times}}$. The number a is called the *base,* and m is called the *exponent,* or *power* of a.)

Familiar Terms and Symbols[3]

- Sum
- Product
- Factor
- Quotient
- Expand
- Term
- Distribute
- Variable or Unknown Number
- Number Sentence
- True or False Number Sentence
- Properties of operations (distributive, commutative, associative)

Suggested Tools and Representations

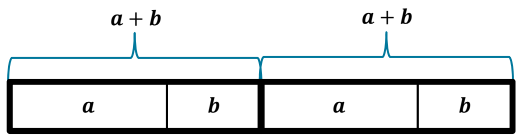
- Bar model
- Geometric figures
- Protractors

Lesson 11

<u>Objective:</u> Factoring Expressions

What expression could we write to represent the model?

$\mathbf{2a + 2b}$



How many $\boldsymbol{a'}$s are in the expression?

$\mathbf{2}$

How many $\boldsymbol{b'}$s are in the expression?

$\mathbf{2}$

What expression could we write to represent the model?

$\mathbf{(a + b) + (a + b) = 2(a + b)}$

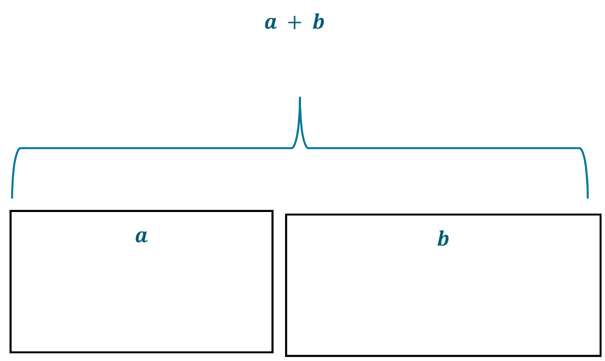
Are the two expressions equivalent?

Yes, both models include $\boldsymbol{2\ a's}$ ***and*** $\boldsymbol{2\ b's}$***. Therefore,*** $\mathbf{2a + 2b = 2(a + b)}$

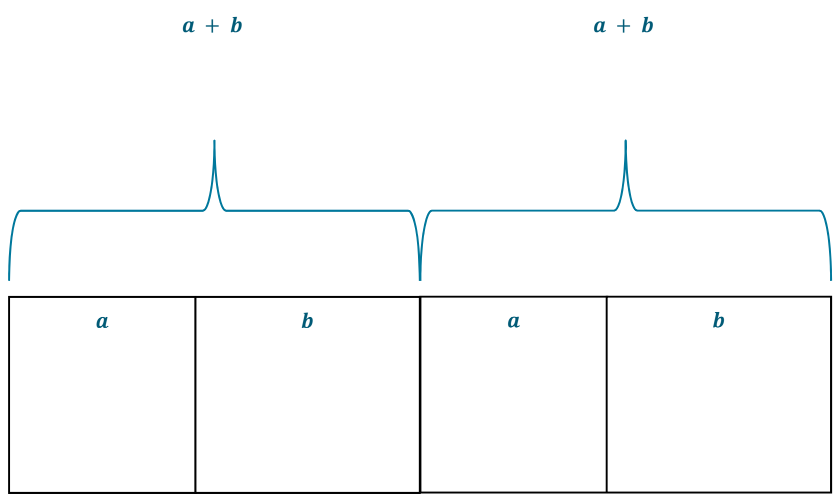
Lesson 12

<u>Objective:</u> Distributing Expressions

Create a model to represent $(\boldsymbol{a} + \boldsymbol{b})$.



The expression $\mathbf{2}(\boldsymbol{a} + \boldsymbol{b})$ tells us that we have $\mathbf{2}$ of the $(\boldsymbol{a} + \boldsymbol{b})$'s. Create a model that shows $\mathbf{2}$ groups of $(\boldsymbol{a} + \boldsymbol{b})$.

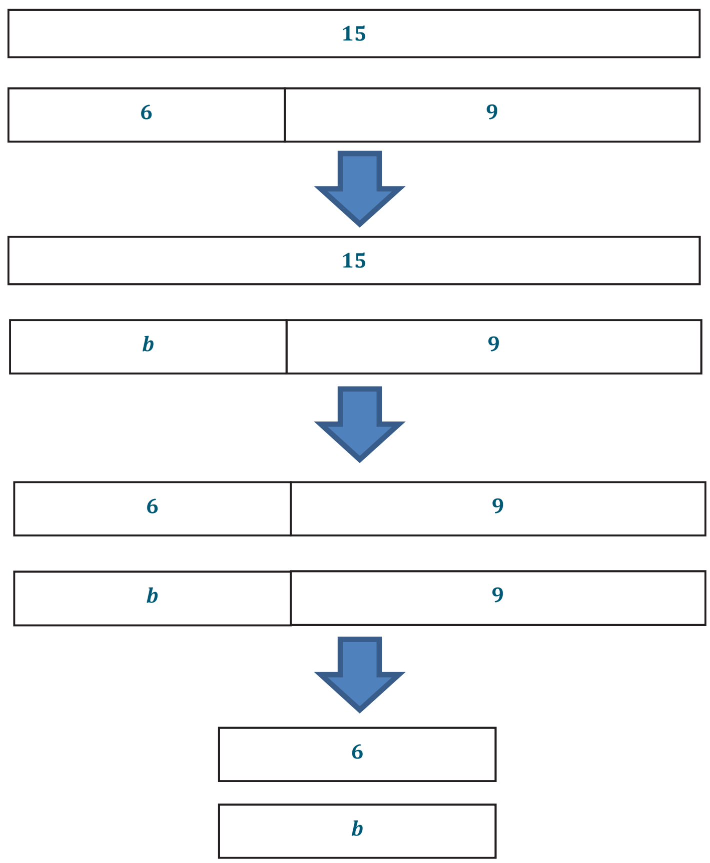


Lesson 26

<u>Objective:</u> One-Step Equations—Addition and Subtraction

Exercise 1

Solve each equation. Use both tape diagrams and algebraic methods for each problem. Use substitution to check your answers. $\boldsymbol{b + 9 = 15}$



<u>Algebraically:</u>

$$b + 9 = 15$$
$$b + 9 - 9 = 15 - 9$$
$$b = 6$$

<u>Check:</u> $\boldsymbol{6 + 9 - 9 = 15 - 9}$; $\boldsymbol{6 = 6}$. This is a true number sentence, so $\boldsymbol{6}$ is the correct solution.

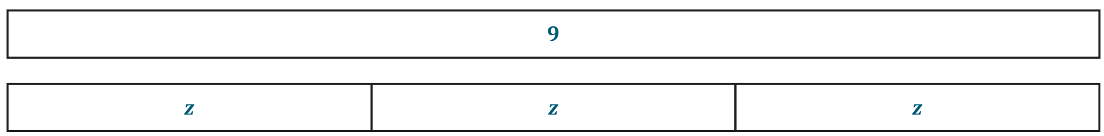
Lesson 27

<u>Objective:</u> One-Step Equations—Multiplication and Division

Example 1

Solve $3z = 9$ using tape diagrams and algebraically. Then, check your answer.

First, draw two tape diagrams, one to represent each side of the equation.



If **9** had to be split into three groups, how big would each group be?

3

Demonstrate the value of *z* using tape diagrams.

a. How can we demonstrate this algebraically?

We know we have to split 9 into three equal groups, so we have to divide by 3 to show this algebraically. $3z \div 3 = 9 \div 3$

b. How does this get us the value of z?

The left side of the equation will equal z, because we know the identity property, where $a \cdot b \div b = a$, so we can use this identity here.

The right side of the equation will be 3 because $9 \div 3 = 3$. Therefore, the value of z is 3.

c. How can we check our answer?

We can substitute the value of z into the original equation to see if the number sentence is true. $\mathbf{3(3) = 9; 9 = 9}$. **This number sentence is true, so our answer is correct.**

Lesson 27

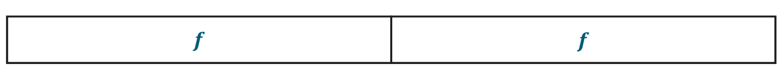
<u>Objective:</u> One-Step Equations—Multiplication and Division

<u>Example</u>

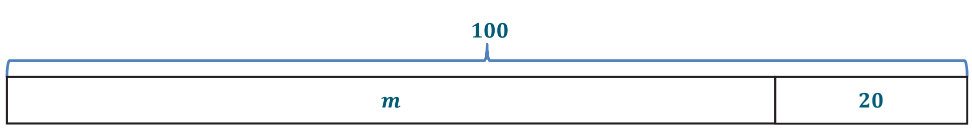
Marissa has twice as much money as Frank. Christina has $\$\mathbf{20}$ more than Marissa. If Christina has $\$\mathbf{100}$, how much money does Frank have? Let $\boldsymbol{f}$ represent the amount of money Frank has in dollars and $\boldsymbol{m}$ represent the amount of money Marissa has in dollars

Draw a tape diagram to represent the amount of money Frank has.

Draw a tape diagram to represent the amount of money Marissa has.



Draw a tape diagram to represent the amount of money Christina has.



Which tape diagram provides enough information to determine the value of the variable m?

The tape diagram that represents the amount of money Christina has.

Write and solve the equation.

$$m + 20 = 100$$
$$m + 20 - 20 = 100 - 20$$
$$m = 80$$

The identities we have discussed throughout the module solidify that $m + 20 - 20 = m$.

a. What does the 80 represent?

80 is the amount of money, in dollars, that Marissa has.

b. Now that we know Marissa has \$$80$, how can we use this information to find out how much money Frank has?

We can write an equation to represent Marissa's tape diagram since we now know the length is 80.

c. Write an equation.

$2f = 80$

d. Solve the equation.

$2f \div 2 = 80 \div 2$ $\qquad\qquad$ $f = 40$

Once again, the identities we have used throughout the module can solidify that $2f \div 2 = f$.

e. What does the 40 represent?

The 40 represents the amount of money Frank has, in dollars.

f. Does 40 make sense in the problem?

Yes, because if Frank has $\$40$, then Marissa has twice this, which is $\$80$. Then, Christina has $\$100$ because she has $\$20$ more than Marissa, which is what the problem stated.

Lesson 29

<u>Objective:</u> Multi-Step Problems—All Operations

Indian Ridge Middle School wanted to add a new school sport, so they surveyed the students to determine which sport is most popular. Students were able to choose between soccer, football, lacrosse, or swimming. The same number of students chose lacrosse and swimming. The number of students who chose soccer was double the number of students who chose lacrosse. The number of students who chose football was triple the number of students who chose swimming. If 434 students completed the survey, how many students chose each sport?

Soccer	Football	Lacrosse	Swimming	Total
2	3	1	1	7

The rest of the table will vary.

Soccer	Football	Lacrosse	Swimming	Total
2	3	1	1	7
124	186	62	62	434

124 students chose soccer, 186 students chose football, 62 students chose lacrosse and 62 students chose swimming.

We can confirm that these numbers satisfy the conditions of the word problem because lacrosse and swimming were chosen by the same number of students. 124 is double 62, so soccer was chosen by double the number of students as lacrosse and 186 is triple 62, so football was chosen by 3 times as many students as swimming. Also, $124 + 186 + 62 + 62 = 434$.

Algebraically: Let s represent the number of students who chose swimming. Then, $2s$ is the number of students who chose soccer, $3s$ is the number of students who chose football and s is the number of students who chose lacrosse.

$$\begin{aligned} 2s + 3s + s + s &= 434 \\ 7s &= 434 \\ 7s \div 7 &= 434 \div 7 \\ s &= 62 \end{aligned}$$

Therefore, 62 students chose swimming and 62 students chose lacrosse. 124 students chose soccer because $2(62) = 124$, and 186 students chose football because $3(62) = 186$

Technology Resources

www.k-5mathteachingresources.com -This site provides an extensive collection of free resources, math games, and hands-on math activities aligned with the Common Core State Standards for Mathematics.

www.parccgames.com – fun games to help kids master the common core standards.

http://www.mathplayground.com –common core educational math games and videos.

www.learnzillion.com – math video tutorials.

www.ixl.com – practice common core interactive math skills practice.

www.mathnook.com –common core interactive math skill practice/ games, worksheets and tutorials.

www.adaptedmind.com – common core interactive practice, video lessons and worksheets

www.brainpop.com – animated tutorials of curriculum content that engages students. Can use a limited free version or buy a subscription.