TOPIC 7

Algebraic Expressions

Lesson 7.1
No Substitute for Hard Work
Evaluating Algebraic Expressions

Lesson 7.2a/b
Mathematics Gymnastics
Rewriting Expressions Using the Distributive Property

Lesson 7.3a/b
All My Xs
Combining Like Terms

TOPIC 7

LESSON 7.1

No Substitute for Hard Work

Objective: Evaluating Algebraic Expressions

Warm-Up

Perform each operation.

1. $(-3)(6.6)$

2. $-3 + 6.6$

3. $-3 - 6.6$

4. $6.6 \div (-3)$

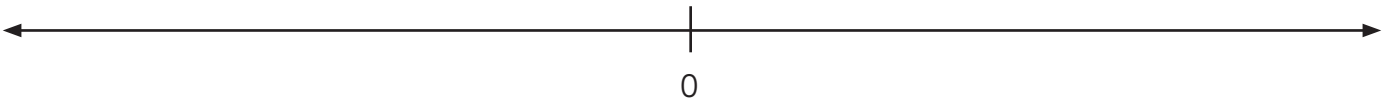
GETTING STARTED

The Empty Number Line

Consider the list of six variable expressions:

x $2x$ $3x$ $\frac{1}{2}x$ $-x$ $-\frac{1}{2}x$

1. With your partner, think about where you would place each expression and sketch your conjecture.



2. Compare your number line with another group's number line.
What is the same? What is different?

EXPLORE 1

Algebraic Expressions

In this lesson, you will explore the relationship between unknown quantities by writing and evaluating **algebraic expressions**. An algebraic expression is a mathematical phrase that has at least one
variable, and it can contain numbers and operation symbols.

Each of the expressions in the Empty Number Line activity is an algebraic expression. They are also **linear expressions**. A linear expression is any expression in which each term is either a constant or the product of a constant and a single variable raised to the first power.

Additional examples of linear expressions include:

$$-\frac{1}{2}x + 2, \quad -3 + 12.5x, \quad 4y, \quad -1 + 3x + \frac{5}{2}x - \frac{4}{3}$$

The expressions $3x^2 + 5$ and $-\frac{1}{2}xy$ are examples of expressions that are not linear expressions.

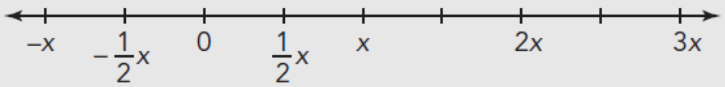
1. Provide a reason why each expression does not represent a linear expression.

Let's revisit how you may have plotted the expressions in the previous activity. The directions did not specify the possible values for x. When you graphed each expression, did you think about the set of all possible values of x or just the set of positive x-values?

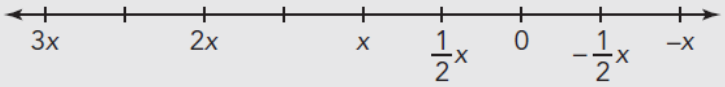
In mathematics, it is sometimes necessary to set constraints on values. A constraint is a condition that a solution or problem must satisfy. A constraint can be a restriction set in advance of solving a problem or a limit placed on a solution or graph so the answer makes sense in terms of a real-world scenario.

Analyze the number lines created by Bella and Tito using the expressions from the Empty Number Line activity.

Bella



Tito



2. Compare and contrast each representation.
a. What are the constraints on each representation? Identify the set of x-values that make each number line true.

b. Select a value for x from your set of possible values and substitute that value for x in each expression to verify the plotted locations are correct.

c. Compare your values from part (b) with your classmates.
Do you have the same values? If not, what does that mean?

EXPLORE 2

Substitution with Rational Numbers

To earn money for a summer mission trip, Levi is working as a handyman around his neighborhood. Levi has been hired to build a wooden fence. He plans to use a post hole digger to dig the holes for the posts.

Levi starts the project on Saturday morning but because of the type of soil, he only starts the holes, fills them with water, and then plans to return Sunday to finish the job. When Levi starts on Sunday, each hole is 3 inches deep. Each time he uses the post hole diggers, he extracts 2 inches of soil. The height of the soil in the hole with respect to ground level can be modeled by the linear expression $-3 - 2n$, where n is the number of times Levi extracted soil with the post hole diggers.

1. Determine the height of the soil in the hole as Levi works.

Number of Soil Extractions	Height of the Soil (inches)
0	
1	
2	
5	
10	
15	
20	

2. From his research about digging post holes, Levi knows that each pole must be placed at a depth that is 2 feet below the frost level, and the frost level is 16 inches beneath ground level.

a. How deep must Levi dig each hole?

b. Determine the minimum number of soil extractions for each hole.

Levi's mom, Maggie, uses a cable tool rig to dig wells during the mission trip. Her rig can dig 12.4 meters of hard rock per day. When Maggie starts working on one well, the hole is already 33 meters deep.

3. Write a linear expression for the height of the hole with respect to ground level for the number of days that Maggie runs the rig.

4. Use your expression to determine the height of the hole after each number of days.

a. 2 days after Maggie starts

b. 5 days after Maggie starts

c. 2 days before Maggie started

EXPLORE 3

Evaluating Expressions

Previously, you evaluated algebraic expressions with positive rational numbers. Now you can evaluate expressions with negative rational numbers. To **evaluate an algebraic expression**, you replace each variable in the expression with a number or numeric expression and then perform all possible mathematical operations.

1. Evaluate each algebraic expression.

a. $x - 7$
- for $x = 28$
- for $x = 211$
- for $x = 16$

c. $3b - 5$
- for $b = -2$
- for $b = 3$
- for $b = 9$

b. $-6y$
- for $y = -3$
- for $y = 0$
- for $y = 7$

d. $-1.6 + 5.3n$
- for $n = -5$
- for $n = 0$
- for $n = 4$

Sometimes, it is more convenient to use a table to record the results when evaluating the same expression with multiple values.

2. Complete each table.

a.

h	$-2h-7$
2	
-1	
8	
-7	

b.

a	-12	-10	-4	0
$\frac{a}{4} + 6$				

c.

x	$x^2 - 5$
1	
3	
6	
-2	

d.

y	-5	-1	0	15
$-\frac{1}{5}y + 3\frac{2}{5}$				

3. Evaluate each algebraic expression for x = 2, −3, 0.5, and $-2\frac{1}{3}$.

a. −3x

b. 5x + 10

c. 6 − 3x

d. 8x + 75

4. Evaluate each algebraic expression for x = 23.76 and $-21\frac{5}{6}$

a. 2.67x − 31.85

b. $11\frac{3}{4}x + 56\frac{3}{8}$

Show You KNOW

Strategies

Write a 1–2 paragraph summary of this lesson. Be sure to address each question.

1. Describe your basic strategy for evaluating any algebraic expression.

2. How are tables helpful when evaluating expressions?

Name: _____ Date: _____ Class: _____

Homework HW

LESSON 7.1

No Substitute for Hard Work

Objective Evaluating Algebraic Expressions

Practice

Evaluate each algebraic expression.

1. $64 - 9p$ for $p = 4, 9, -3$
2. $-w + 8.5$ for $w = 12, -1.5, 5.3$
3. $46 + (-2k)$ for $k = 3, 23, -2$

Complete each table.

4.

b	$3b + 14$
-5	
-3	
0	
4	

5.

v	1	2	5	-3.25
$6.75 - 6v$				

6.

f	4	8	-12	-1
$\frac{f}{4} + 3f$				