## Lesson 15 Part 1: Introduction Writing Linear Expressions

## You've learned how different expressions can represent the same situation. Take a look at this problem.

This swimming pool was designed so that sections of the pool can be used for different activities. The dimensions are given in meters. Write three different expressions to represent the total surface area of the pool.


## Explore It

## Use the math you already know to solve the problem.

- You can think about the total surface area of the pool as the sum of the surface areas of the swimming sections and the other sections. Write an expression that represents this way of thinking about the total surface area.


You can think about the total surface area as $25(8)+7(8)+25 x+7 x$. Draw and label a picture that shows this way of thinking about the total surface area.

You can think about the total surface area as $(25+7)(8+x)$. Explain the thinking behind this expression.

## Q Find Out More

The expressions that you wrote to represent the surface area of the pool are equivalent expressions. Each expression shows a different way of looking at the situation.

You can use properties of operations to show that expressions are equivalent. Another way to test whether two or more expressions are equivalent is to evaluate them for specific values of the variable. For example, you could evaluate each expression for $x=10$.

$$
\begin{aligned}
& 25(8+x)+7(8+x)=25(8+10)+7(8+10) \\
&=25(18)+7(18) \\
&=450+126 \\
&=576 \\
& 25(8)+7(8)+25 x+7 x=25(8)+7(8)+25(10)+7(10) \\
&=200+56+250+70 \\
&=576 \\
& \\
& \begin{aligned}
(25+7)(8+x) & =(25+7)(8+10) \\
& =32(18) \\
& =576
\end{aligned}
\end{aligned}
$$

No matter which expression you use to find the total surface area of the pool, you get 576 square meters as your answer. The three expressions are equivalent. If you choose a different value for $x$, the three expressions will have a different value, but they will all be equal.

## Reflect

1 If you know the value of $x$, which expression would you use to find the total surface area of the pool? Explain.
$\qquad$
$\qquad$
$\qquad$

## Read the problem below. Then explore different ways to write an expression to solve the problem.

A group of rectangular community gardens is being built on an empty city block. The length of each garden will be 90 feet, but the widths of the gardens will vary. Let $g$ stand for the width of a garden. Think about different ways to find the perimeter of each garden. Then write an expression to represent each different way.

## Picture It

## You can think about the perimeter of the rectangle as the sum of its sides.

You can think about walking around the rectangle. The sum of its sides equals:

$$
90+g+90+g
$$



## Picture It

## You can think about the perimeter of the rectangle as the sum of twice its length and

 twice its width.If you see the perimeter as the sum of two equal lengths and two equal widths, you can multiply the length by 2 and the width by 2 and then add the products.


## Connect It

## Now you will write the perimeter in a third way and show that all the expressions are equivalent.

2 Look at the diagrams on the previous page. Find the lengths of two adjacent sides. Write an expression for the sum of two adjacent sides.

3 The other pair of adjacent sides have the same sum. Explain how you could think of the perimeter of the rectangular garden as a product of the sum of two sides.

4 Write an expression for the perimeter of the rectangular garden as a product of the sum of two sides.

5 Now use all three ways to show how to find the perimeter of a rectangular garden that is 16 feet long and 5 feet wide.

6 Does it matter which expression you use to find the perimeter? Explain.
$\qquad$
$\qquad$

## Try lt

## Use what you just learned to solve these problems. Show your work.

7 Students in Jay's school plant vegetables in one of the rectangular gardens with length 90 feet and width $7 \frac{1}{2}$ feet. Use each of the expressions above to find the garden's perimeter. Show that all three expressions produce the same measurement.
$\qquad$
$\qquad$
$\qquad$

8 Write the following expression in two different ways: $\frac{1}{2}(a+b)$.
$\qquad$

## Read the problem below. Then explore how to write different expressions to represent and solve it.

The original price of a backpack is $\$ 40.90$. The sale price is $30 \%$ off. Write two different expressions to represent its sale price.

## Q. Picture It

## You can draw a bar diagram to represent the situation.

The whole bar represents the original price of the backpack.
The shaded section represents the $30 \%$ discount.
$\$ 40.90$


## Model It

You can calculate the sale price by subtracting the $\mathbf{3 0 \%}$ discount from the original price.

$$
\begin{aligned}
\text { sale price } & =\text { original price }- \text { discount } \\
\text { sale price } & =\text { original price }-30 \% \text { of the original price } \\
& =40.90-0.30(40.90)
\end{aligned}
$$

## Q Model It

You can calculate the sale price by finding 70\% of original price.
sale price $=70 \%$ of the original price

$$
=0.70(40.90)
$$

## Connect It

## Now you will show that both expressions give you the same sale price.

9 Explain how you could find the sale price of the backpack using two operations.

10 Calculate the sale price of the backpack using two operations. Show your work.
$\qquad$
$\qquad$
11 Explain how you could find the sale price of the backpack using one operation.
$\qquad$
$\qquad$
12 Calculate the sale price of the backpack using one operation. Show your work.
$\qquad$
$\qquad$
13 Suppose the price of the backpack was $p$ dollars. Write two different expressions to represent the sale price.

## Try It

## Use what you just learned to solve these problems. Show your work.

14 The price of a flash drive that regularly sells for $\$ 16$ is increased by $15 \%$. Write two different expressions to find the new price.

15 The original price of a DVD is represented by the variable $x$. If the DVD is discounted $45 \%$, write a subtraction expression and a multiplication expression to represent its sale price.
$\qquad$

The student wrote an expression by finding the increase and adding it to the original cost.


## Pair/Share

What is another way to write an expression to represent the sale price?

What do I know about a rectangle that will help me solve this problem?


## OPair/Share

How many different ways can you represent the perimeter of the rug?

## Study the student model below. Then solve problems 16-18.

Student Model
A store manager paid $\$ 15$ for a computer case and sells it in the store for $65 \%$ more than she paid. What expression represents the price of the computer case in the store?

Look at one way you could write an expression.

$$
\text { original price }+65 \% \text { of original price }=\text { sale price }
$$



Solution: $15+0.65(15)$

16 A hand-woven rectangular rug measures $x \mathrm{ft}$ long and $2 \frac{4}{5} \mathrm{ft}$ wide. Write an expression to represent the perimeter of the rug.
Show your work.

Solution: $\qquad$

17 A customer calculated the cost of a new jacket, c, including a 7\% sales tax, by multiplying 0.07 times the cost of the jacket and adding the product to the cost of the jacket. What is another way to calculate the price including tax? What expression represents the total cost?
Show your work.

Solution: $\qquad$

18 The price of a $\$ 198.00$ smart phone is discounted $40 \%$ for a special promotion. What is its sale price during the promotion? Circle the correct answer.

A $\$ 190.08$
B $\$ 120.80$
C $\$ 118.80$
D $\quad \$ 79.20$
Courtney chose D as the correct answer. How did she get that answer?
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Solve the problems.

1 Jonathan and Trina both earn $\$ 12$ per hour, but Trina earned a $\$ 15$ bonus this week for being on time every day. Let $J=$ number of hours that Jonathan worked this week and $T=$ number of hours that Trina worked this week. Which expression represents the total amount that Jonathan and Trina earned this week?

A $\quad 12(J+T+15)$
B $\quad 12(J+15)+12(T+15)$
C $\quad 15(J+T)+12$
D $\quad 12(J+T)+15$

2 For expressions A-E, select Yes or No to indicate whether each expression is equivalent to $3(x+2)$.

A $3 x+2$
B $3(2+x)$
C $3 x+2 x$
D $x+2 x+2+4$
E $\quad x+x+x+1+1+1+1+1+1$


3 A store is advertising a sale with $15 \%$ off all prices in the store. Sales tax is $8 \%$. Which equation will correctly determine the total cost, $C$, of buying an item with an original price of $p$, after the discount and sales tax are included? Select all that apply.

A $C=1.08 p-0.15 p$
B $\quad C=1.15 p+0.08 p$
C $C=1.08(0.85 p)$
D $\quad C=0.85 p+(0.08) 0.85 p$
E $\quad C=p-0.15 p+0.08 p$

4 The length of a rectangle is $x$ feet. Its width is $(x-7)$ feet. Draw and label a rectangle to represent this situation. Then write three different expressions you could use to find its perimeter.

Show your work.

Answer $\qquad$

5 The perimeter of an equilateral triangle is $6 x-6.3$. Draw and label a triangle to represent this situation. Then write an expression to represent its perimeter as a sum. Then write an expression to represent its perimeter as a product.

Show your work.

## Answer

$\qquad$

Self Check Go back and see what you can check off on the Self Check on page 125.

