Prime Time UNIT
Main Focus: Factors & Multiples

Factors and Multiples: Understand relationships among factors, multiples, divisors, and products.

- Classify numbers as prime, composite, even, odd, or square
- Recognize that factors of a number occur in pairs
- Recognize situations that call for common factors and situations that call for common multiples
- Recognize situations that call for the greatest common factor and situations that call for the least common multiple
- Recognize and use the fact that every whole number can be written in exactly one way as a product of prime numbers
- Use exponential notation to write repeated factors
- Relate the prime factorization of two numbers to the least common multiple and greatest common factor of two numbers
- Solve problems involving factors and multiples

3  ×  4  =  12

3 is a factor of 12.
3 is a divisor of 12.
4 is a factor of 12.
4 is a divisor of 12.
12 is the product of 3 and 4.
12 is a multiple of 3.
12 is a multiple of 4.
12 is divisible by 3.
12 is divisible by 4.

Equivalent Expressions: Understand why two expressions are equivalent.

- Relate the area of a rectangle to the Distributive Property
- Recognize that the Distributive Property relates the multiplicative and additive structures of whole numbers
- Solve problems involving the Order of Operations and Distributive Property
- Recognize that the Distributive Property relates the multiplicative and additive structures of whole numbers
- Use the properties of operations of numbers, including the Distributive Property, and the Order of Operations convention to write equivalent numerical expressions
- Solve problems involving the Order of Operations and Distributive Property

### Distributive Property

<table>
<thead>
<tr>
<th>Algebra</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a(b + c) = a(b) + a(c))</td>
<td>(9(4 + 5) = 9(4) + 9(5))</td>
</tr>
<tr>
<td>(a(b - c) = a(b) - a(c))</td>
<td>(5(8 - 2) = 5(8) - 5(2))</td>
</tr>
</tbody>
</table>
Words and Phrases to Math Symbols

Addition
- Plus
- And
- Total of
- Altogether
- Increased By
- Combined
- Add
- Sum
- Together
- More Than
- Added To
- In All
- Make

Subtraction
- Subtract
- Gave
- Take Away
- Decrease By
- Fewer
- Minus
- Shared
- Fewer Than
- Less Than
- Difference
- Less

Multiplication
- Times
- Triple
- Double
- Product
- Multiplied By
- Of
- Increased By a Factor
- Twice
- Multiple

Division
- Quotient of
- Per
- Ratio of
- Divided By
- Half
- Divisor
- Divided Into
- Percent
- Split Up

Equals
- Is
- Are
- Were
- Was
- Will Be
- Yields
- Sold For

Parenthesis Words
- The Quantity of
- Twice the sum of
- Times the sum of
- Times the difference of
- Plus the difference of
Factors are the numbers you multiply to get another number.

**Prime numbers** are the numbers that have only two factors.  
What are the factors of 3? 1 and 3  
Because 3 has only two factors, it is a prime number.

**Composite numbers** are the numbers that have more than two factors.  
What are the factors of 6? 1, 2, 3, and 6  
Because 6 has more than two factors, it is a composite number.

Complete the table.

<table>
<thead>
<tr>
<th>Number</th>
<th>List of Factors</th>
<th>Prime or composite?</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Complete Each Family of Facts

1) \[
\begin{align*}
10 & \times 5 = 50 \\
10 & \times 5 = 50 \\
5 & \div 10 = 5 \\
5 & \div 10 = 5
\end{align*}
\]

4) \[
\begin{align*}
3 & \times 9 = 27 \\
3 & \times 9 = 27 \\
9 & \div 3 = 3 \\
9 & \div 3 = 3
\end{align*}
\]

2) \[
\begin{align*}
4 & \times 6 = 24 \\
4 & \times 6 = 24 \\
6 & \div 4 = 3 \\
6 & \div 4 = 3
\end{align*}
\]

5) \[
\begin{align*}
6 & \times 4 = 24 \\
6 & \times 4 = 24 \\
4 & \div 6 = \frac{2}{3} \\
4 & \div 6 = \frac{2}{3}
\end{align*}
\]

3) \[
\begin{align*}
2 & \times 8 = 16 \\
2 & \times 8 = 16 \\
8 & \div 2 = 4 \\
8 & \div 2 = 4
\end{align*}
\]

6) \[
\begin{align*}
8 & \times 3 = 24 \\
8 & \times 3 = 24 \\
3 & \div 8 = \frac{3}{8} \\
3 & \div 8 = \frac{3}{8}
\end{align*}
\]
Find the Prime Factors of the Numbers

1) \[ 132 \]
   \[
   \begin{array}{c}
   \_ \_ \_ \_ \_ \\
   \_ \_ \_ \\
   \_ \_ \\
   \_ \\
   \end{array}
   \]

2) \[ 24 \]
   \[
   \begin{array}{c}
   \_ \_ \_ \_ \_ \\
   \_ \_ \\
   \_ \\
   \_ \\
   \end{array}
   \]

3) \[ 18 \]
   \[
   \begin{array}{c}
   \_ \_ \_ \\
   \_ \_ \\
   \_ \\
   \_ \\
   \end{array}
   \]

Prime Factors
\[ \_ x \_ x \_ x \_ = 132 \]

Prime Factors
\[ \_ x \_ x \_ x \_ = 24 \]

Prime Factors
\[ \_ x \_ x \_ = 18 \]

4) \[ 90 \]
   \[
   \begin{array}{c}
   \_ \_ \_ \_ \_ \\
   \_ \_ \_ \\
   \_ \_ \\
   \_ \\
   \end{array}
   \]

5) \[ 75 \]
   \[
   \begin{array}{c}
   \_ \_ \_ \_ \_ \\
   \_ \_ \\
   \_ \\
   \_ \\
   \end{array}
   \]

6) \[ 50 \]
   \[
   \begin{array}{c}
   \_ \_ \_ \_ \_ \\
   \_ \_ \_ \\
   \_ \\
   \_ \\
   \end{array}
   \]

Prime Factors
\[ \_ x \_ x \_ x \_ = 90 \]

Prime Factors
\[ \_ x \_ x \_ = 75 \]

Prime Factors
\[ \_ x \_ x \_ = 50 \]
### Finding Greatest Common Factor

**Determine the greatest common factor (GCF) of each set of numbers.**

1. **12, 16**
   - To find the GCF of 12 & 16, first write down the factors of each number.
   - Factors of 12: 1, 2, 3, 4, 6, 12
   - Factors of 16: 1, 2, 4, 8, 16
   - 2 & 4 are factors both 12 and 16 have in common, with 4 being the greatest. So 4 is the GCF.

2. **18, 27**
   - Factors of 18: 1, 2, 3, 6, 9, 18
   - Factors of 27: 1, 3, 9, 27
   - The greatest common factor is 9.

3. **20, 30**
   - Factors of 20: 1, 2, 4, 5, 10, 20
   - Factors of 30: 1, 2, 3, 5, 6, 10, 15, 30
   - The greatest common factor is 10.

4. **24, 36**
   - Factors of 24: 1, 2, 3, 4, 6, 8, 12, 24
   - Factors of 36: 1, 2, 3, 4, 6, 9, 12, 18, 36
   - The greatest common factor is 12.

5. **30, 45**
   - Factors of 30: 1, 2, 3, 5, 6, 10, 15, 30
   - Factors of 45: 1, 3, 5, 9, 15, 45
   - The greatest common factor is 15.

6. **45, 60**
   - Factors of 45: 1, 3, 5, 9, 15, 45
   - Factors of 60: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
   - The greatest common factor is 15.

### Answers

1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______

---

**Math**

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Identifying Factors

List the factors for each of the numbers.

Factors are the numbers you multiply together to get another number.

Factors of 12: __, __, __, __, __, __, __, __, __, __, __, __

1 × 12 = 12  2 × 6 = 12  3 × 4 = 12

*Note: Negative numbers can also be factors. (I.e. -1, -2, -3, -4, -6, -12)

1) 12 __, __, __, __, __, __, __
2) 61 __, __
3) 69 __, __, __, __
4) 6 __, __, __, __
5) 21 __, __, __, __
6) 51 __, __, __, __
7) 22 __, __, __, __
8) 25 __, __, __
9) 43 __, __
10) 62 __, __, __, __
11) 61 __, __
12) 16 __, __, __, __, __
13) 98 __, __, __, __, __
14) 86 __, __, __, __
15) 29 __, __
Finding Least Common Multiple

Find the least common multiple of both numbers.

To find the least common multiple one strategy is to list the multiples of the numbers.

<table>
<thead>
<tr>
<th>4</th>
<th>8</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>36</th>
<th>40</th>
<th>44</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>30</td>
<td>36</td>
<td>42</td>
<td>48</td>
<td>54</td>
<td>60</td>
<td>66</td>
<td>72</td>
</tr>
</tbody>
</table>

Some of the multiples 4 and 6 have in common are: 12, 24, 36 & 48. The common multiple that is least is 12.

1) 6
   8

2) 4
   12

3) 11
   5

4) 2
   8

5) 11
   12

6) 6
   7

7) 9
   5

8) 2
   5

9) 2
   9

10) 3
    6
PEMDAS Rules

Evaluate the problem in the following order:

1) P  - Parentheses
2) E  - Exponents (Powers and Square Roots)
3) MD - Multiplication and Division (Left to Right)
4) AS - Addition and Subtraction (Left to Right)

You can remember the order by saying:

Please Excuse My Dear Aunt Sally

a x u i d u
r p l v d b
e o t i i t
n s t r
e n p i i r
h e l o n c
s e c a t i o
s e c a t i o

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Order of Operations

1) \((7 + 3)^2 + (14 \div 2)\)

2) \((8 + 4)^2 + (10 \div 5)\)

3) \((7 \times 6 + 3^2) - 7\)

4) \(2 \times (12 - 6) - 9^2\)

5) \((63 - 3) \div 2 - 7^2\)

6) \((13 \times 5 + 6^2) + 10\)

7) \((76 - 6^2) \div (-4 + 6)\)

8) \(4 \times (9 + 5) + 7^2\)

9) \((42 - 6) \div 12 - 4^2\)

10) \((44 - 4^2) \div (6 - 4)\)
1.4 The Distributive Property

Essential Question How do you multiply two 2-digit numbers using mental math?

1 ACTIVITY: Finding Products Involving Multiples of 10

Working with a partner, take turns using mental math to find the product.

Read the expression to your partner. Then ask your partner to write the answer.

a. $10 \times 20$  
   b. $10 \times 30$  
   c. $10 \times 13$  
   d. $24 \times 10$

   e. $20 \times 25$  
   f. $30 \times 12$  
   g. $13 \times 40$  
   h. $30 \times 70$

In Activity 1, you used mental math to find simple products. You can use the Distributive Property and mental math to find more complicated products.

The Meaning of a Word Distribute

When you distribute something to each person in a group, you give that thing to each person in the group.

2 ACTIVITY: Using Mental Math

Work with a partner. Use the Distributive Property and mental math to find the product.

a. Sample: $6 \times 23$

   $6 \times 23 = 6 \times (20 + 3)$
   $= (6 \times 20) + (6 \times 3)$
   $= 120 + 18$
   $= 138$

   $\therefore$ So, $6 \times 23 = 138$.

b. $4 \times 17$
   c. $8 \times 26$
   d. $7 \times 33$
   e. $9 \times 47$
3. **ACTIVITY: Two Ways to Multiply**

Work with a partner. Find the product two different ways. Compare the two methods.

**a. Sample: 63 \times 28**

**Method 1**

\[
\begin{align*}
63 & \times 28 \\
\times & 28 \\
504 & \\
+ & 1260 \\
\hline
1764 &
\end{align*}
\]

**Method 2**

\[
\begin{align*}
63 & \times 28 \\
\leftarrow 63 & \text{is 60 + 3.} \\
28 & \text{is 20 + 8.} \\
1200 & \text{Multiply 20 and 60.} \\
60 & \text{Multiply 20 and 3.} \\
480 & \text{Multiply 8 and 60.} \\
+ & 24 \text{ Add.} \\
1764 &
\end{align*}
\]

**b. 32 \times 45**

**d. 28 \times 57**

**c. 37 \times 61**

4. **ACTIVITY: Using Mental Math**

Work with a partner. Use the Distributive Property and mental math to find the product.

**a. Sample: 60 \times 49**

\[
\begin{align*}
60 \times 49 & = 60 \times (50 - 1) \\
& = (60 \times 50) - (60 \times 1) \\
& = 3000 - 60 \\
& = 2940 \\
\therefore 60 \times 49 & = 2940.
\end{align*}
\]

**b. 20 \times 19**

**c. 40 \times 29**

**d. 25 \times 39**

**e. 15 \times 47**

What Is Your Answer?

5. **IN YOUR OWN WORDS** How can you multiply two 2-digit numbers using mental math? Use an example in your answer.

Practice

Use what you learned about the Distributive Property to complete Exercises 4–7 on page 26.
**1.4 Lesson**

**Key Idea**

**Distributive Property**

**Words** To multiply a sum or difference by a number, multiply each number in the sum or difference by the number outside the parentheses. Then evaluate.

**Numbers**

\[
3(7 + 2) = 3 \times 7 + 3 \times 2 \\
3(7 - 2) = 3 \times 7 - 3 \times 2
\]

**Algebra**

\[
a(b + c) = ab + ac \\
a(b - c) = ab - ac
\]

**EXAMPLE 1 Using Mental Math**

Use the Distributive Property and mental math to find \(8 \times 53\).

\[
8 \times 53 = 8(50 + 3) \quad \text{Write } 53 \text{ as } 50 + 3.
\]

\[
= 8(50) + 8(3) \quad \text{Distributive Property}
\]

\[
= 400 + 24 \quad \text{Multiply.}
\]

\[
= 424 \quad \text{Add.}
\]

On Your Own

Use the Distributive Property and mental math to find the product.

1. \(5 \times 41\)  
2. \(12 \times 32\)  
3. \(9 \times 19\)  
4. \(6(37)\)

**EXAMPLE 2 Simplifying Algebraic Expressions**

Use the Distributive Property to simplify the expression.

a. \(4(n + 5)\)

\[
4(n + 5) = 4(n) + 4(5) \quad \text{Distributive Property}
\]

\[
= 4n + 20 \quad \text{Multiply.}
\]

b. \(12(y - 3)\)

\[
12(y - 3) = 12(y) - 12(3) \quad \text{Distributive Property}
\]

\[
= 12y - 36 \quad \text{Multiply.}
\]

On Your Own

Use the Distributive Property to simplify the expression.

5. \(7(a + 2)\)  
6. \(10(9 + b)\)  
7. \(6(b - 7)\)  
8. \(3(d - 11)\)

24 Chapter 1 Expressions and Number Properties
EXAMPLE 3 Standardized Test Practice

Which expression is equivalent to \(9(6 + x + 2)\)?

[A] \(9x + 8\)  
[B] \(9x + 54\)  
[C] \(9x + 56\)  
[D] \(9x + 72\)

\[
9(6 + x + 2) = 9(6) + 9(x) + 9(2)  
= 54 + 9x + 18  
= 9x + 54 + 18  
= 9x + 72
\]

::: The correct answer is (D).

On Your Own

Use the Distributive Property to simplify the expression.

9. \(2(n + 5 + 12)\)  
10. \(15(y + 3 + 7)\)  
11. \(5(10 + z + 9)\)  
12. \(3(x + 11 + 4)\)  
13. \(7(2 + 6 + d)\)  
14. \(8(20 + 25 + w)\)

EXAMPLE 4 Real-Life Application

José is \(x\) years old. His brother, Felipe, is 2 years older than José. Their aunt, Maria, is three times as old as Felipe. Write and simplify an expression that represents Maria's age in years.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>José</td>
<td>He is (x) years old.</td>
<td>(x)</td>
</tr>
<tr>
<td>Felipe</td>
<td>He is 2 years older than José. So, add 2 to (x).</td>
<td>(x + 2)</td>
</tr>
<tr>
<td>Maria</td>
<td>She is three times as old as Felipe. So, multiply 3 and ((x + 2)).</td>
<td>(3(x + 2))</td>
</tr>
</tbody>
</table>

\[
3(x + 2) = 3(x) + 3(2)  
= 3x + 6
\]

::: Maria's age in years is represented by the expression \(3x + 6\).

On Your Own

15. Alexis is \(x\) years old. Her sister, Gloria, is 7 years older than Alexis. Their grandfather is five times as old as Gloria. Write and simplify an expression that represents their grandfather's age in years.

Section 1.4 The Distributive Property 25
1. **WRITING** One meaning of the word *distribute* is to give something to each member of a group. How can this help you remember the Distributive Property?

2. **OPEN-ENDED** Write an algebraic expression in which you use the Distributive Property and then the Associative Property of Addition to simplify.

3. **WHICH ONE DOESN’T BELONG?** Which expression does *not* belong with the other three? Explain your reasoning.
   
   \[ 2(x + 2) \quad 5(x - 8) \quad 4 + (x \cdot 4) \quad 8(9 - x) \]

---

### Practice and Problem Solving

**Use the Distributive Property and mental math to find the product.**

4. \( 3 \times 21 \)
5. \( 9 \times 76 \)
6. \( 12(43) \)
7. \( 5(88) \)
8. \( 18 \times 52 \)
9. \( 8 \times 27 \)
10. \( 8(63) \)
11. \( 7(28) \)

**Use the Distributive Property to simplify the expression.**

12. \( 3(x + 4) \)
13. \( 10(b - 6) \)
14. \( 6(s - 9) \)
15. \( 7(b + y) \)
16. \( 8(12 + a) \)
17. \( 9(n + 1) \)
18. \( 12(6 - k) \)
19. \( 18(w + 5) \)
20. \( 9(3 + c + 4) \)
21. \( 7(8 + x + 2) \)
22. \( 8(g + 5 + 2) \)
23. \( 6(10 + z + 3) \)
24. \( 6(x + 4) + 3 \)
25. \( 5 + 8(3 + x) \)
26. \( 9 + 8(x + 2) \)
27. \( 5(8 + x) + 12 \)

28. **ERROR ANALYSIS** Describe and correct the error in rewriting the expression.

\[ 6(y + 8) = 6y + 8 \]

---

29. **ART MUSEUM** A class of 30 students visits an art museum and a special exhibit while there.
   
   a. Use the Distributive Property to write and simplify an expression for the cost.
   
   b. Estimate a reasonable value for \( x \). Explain.
   
   c. Use your estimate for \( x \) to evaluate both expressions in part (a). Are the values the same?

---

30. **FITNESS** Each day, you run on a treadmill for \( r \) minutes and lift weights for 15 minutes. Which expressions can you use to find how many minutes of exercise you do in 5 days? Explain your reasoning.

\[ 5(r + 15) \quad 5r + 5 \cdot 15 \quad 5r + 15 \quad r(5 + 15) \]
31. **SPEED** A cheetah can run 103 feet per second. A zebra can run \( x \) feet per second. Use the Distributive Property to write and simplify an expression for how much farther the cheetah can run in 10 seconds.

**GEOMETRY** Use the Distributive Property to write and simplify an expression for the area of the rectangle.

32. \[
\begin{array}{c}
8 \\
x + 8
\end{array}
\]

33. \[
\begin{array}{c}
13 \\
x
\end{array}
\]

34. \[
\begin{array}{c}
9 \\
7 \\
x \\
5
\end{array}
\]

**ALGEBRA** Find the value of \( x \) that makes the expressions equivalent.

35. \( 4(x - 5); 32 - 20 \)  
36. \( 2(x + 9); 30 + 18 \)  
37. \( 7(8 - x); 56 - 21 \)

Use the Distributive Property to rewrite the expression as a product.

38. \( 4x + 36 \)  
39. \( 6 + 2x \)  
40. \( 75 - 5x \)  
41. \( 7 + 14x + 21 \)

42. **REASONING** Simplify the expressions and compare.

   a. \( 4(x + 6) \)
   
   b. \( (x + 6) + (x + 6) + (x + 6) + (x + 6) \)

   c. Compare the expressions and results in parts (a) and (b). What do you notice? Explain.

43. **FUNDRAISER** An art club sells 42 large candles and 56 small candles.

   a. Use the Distributive Property to write and simplify an expression for the profit.
   
   b. A large candle costs \$5 and a small candle costs \$3. What is the club’s profit?

44. **PUZZLE** Add one set of parentheses to the expression \( 7 \cdot x + 3 + 8 \cdot x + 3 \cdot x + 8 - 9 \) so that it is equivalent to \( 2(9x + 10) \).

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**Fair Game Review** What you learned in previous grades & lessons

Evaluate the expression when \( x = 5 \) and \( y = 24 \).

45. \( x + 9 \)  
46. \( y + 3 \)  
47. \( xy \)  
48. \( y - x \)

Tell whether the fraction is in simplest form. If not, simplify it.

49. \( \frac{8}{12} \)  
50. \( \frac{6}{35} \)  
51. \( \frac{38}{62} \)  
52. \( \frac{16}{27} \)

53. **MULTIPLE CHOICE** What is the surface area of a cube that has a side length of 8 feet?

   A. \( 64 \text{ ft}^2 \)  
   B. \( 192 \text{ ft}^2 \)  
   C. \( 384 \text{ ft}^2 \)  
   D. \( 512 \text{ ft}^2 \)