Grade 7 Unit 5 Family Materials

Multiplying and Dividing Rational Numbers

This week your student will be multiplying and dividing with negative numbers. The rules for multiplying positive and negative numbers are designed to make sure that addition and multiplication work the same way they always have.

For example, in elementary school students learned to think of "4 times 3" as 4 groups of 3, like $4 \cdot 3 = 3+3+3 = 12$. We can think of "4 times -3" the same way:

$4 \cdot -3 = (-3)+(-3)+(-3)+(-3) = -12$. Also, an important property of multiplication is that we can multiply numbers in either order. This means that $-3 \cdot 4 = 4 \cdot -3 = -12$.

What about $-3 \cdot -4$? It may seem strange, but the answer is 12. To understand why this is, we can think of -4 as $(0-4)$.

$$(-3) \cdot (-4)$$

$$(-3) \cdot (0-4)$$

$$(-3 \cdot 0)-(-3 \cdot 4)$$

$$0 - -12$$

$$12$$

After more practice, your student will be able to remember this without needing to think through examples:

- A positive times a negative is a negative.
- A negative times a positive is a negative.
- A negative times a negative is a positive.

Here is a task to try with your student:

1. Calculate $5 \cdot -2$.
2. Use your answer to the previous question to calculate:

   a. $-2 \cdot 5$

   b. $-2 \cdot -5$

   c. $-5 \cdot -2$

Solution:

1. The answer is -10. We can think of $5 \cdot -2$ as 5 groups of -2, so

   $5 \cdot -2 = (-2) + (-2) + (-2) + (-2) + (-2) = -10$
2.
   a. The answer is -10. We can multiply numbers in either order, so

      $-2 \cdot 5 = 5 \cdot -2 = -10$
   b. The answer is 10. We can think of -5 as $(0-5)$, and

      $-2 \cdot (0-5) = 0 - -10 = 10$.
   c. The answer is 10. Possible Strategies:

      - We can think of -2 as $(0-2)$, and $-5 \cdot (0-2) = 0 - -10 = 10$.
      - We can multiply numbers in either order, so

        $-5 \cdot -2 = -2 \cdot -5 = 10$.

Four Operations with Rational Numbers

This week your student will use what they know about negative numbers to solve equations.

- The *opposite* of 5 is -5, because 5+-5=0. This is also called the additive inverse.
- The *reciprocal* of 5 is $\frac{1}{5}$, because $5 \cdot \frac{1}{5}$ =1. This is also called the multiplicative inverse.

Thinking about opposites and reciprocals can help us solve equations. For example, what value of x makes the equation x+11=-4 true?

$$x + 11 = \text{-}4$$
$$x + 11 + \text{-}11 = \text{-}4 + \text{-}11$$
$$x = \text{-}15$$

11 and -11 are opposites.

The solution is -15.

What value of y makes the equation $-\frac{1}{3}$ y=6 true?

$$\frac{\text{-}1}{3}y = 6$$
$$\text{-}3 \cdot \frac{\text{-}1}{3}y = \text{-}3 \cdot 6$$
$$y = \text{-}18$$

$-\frac{1}{3}$ and -3 are reciprocals.

The solution is -18.

Here is a task to try with your student:

Solve each equation:

25+a=17

-4b=-30

$-\frac{3}{4}$ c=12

Solution:

1. -8, because 17+-25=-8.
2. 7.5 or equivalent, because $-\frac{1}{4}$ ·-30=7.5.

3. -16, because $-\frac{4}{3}$ · 12=-16.