

Operation with Signed Numbers - Multiplication and Division

Part 1: Collecting Data

DIRECTIONS: Multiplication is often thought of as a shortcut for addition, or as thinking of groups of things. In this activity, you will use manipulatives to discover rules for multiplying and dividing positive and negative integers.

For each problem in Experiments 1-4, record the results in the space provided. Your answer should include the number of beans in the result, along with the color of the beans. You may use a W for white and a R for red.

Experiment 1

1. Show 3 groups of 2 red beans.
2. Show 2 groups of 4 red beans.
3. Show 4 groups of 3 red beans.
4. Show 2 groups of 5 red beans.

Experiment 2

5. Show 2 groups of 3 white beans.
6. Show 4 groups of 2 white beans.
7. Show 3 groups of 5 white beans.
8. Show 3 groups of 4 white beans.

Experiment 3

DIRECTIONS: Begin each of the following problems with a zero board (a board containing an equal number of red and white beans).

9. Remove 3 groups of 4 red beans.
10. Remove 2 groups of 3 red beans.
11. Remove 4 groups of 3 red beans.
12. Remove 2 groups of 5 red beans.

Experiment 4

DIRECTIONS: Begin each of the following problems with a zero board (a board containing an equal number of red and white beans).

13. Remove 2 groups of 3 white beans.
14. Remove 4 groups of 2 white beans.
15. Remove 5 groups of 3 white beans.
16. Remove 3 groups of 4 white beans.

Part 2: Analyzing Data

DIRECTIONS: Compare your results with those of the other members of your group. Discuss any differing answers. For each problem, make sure all the members of your group agree on one answer and on the method for finding the answer. Then answer the following questions in your journal.

1. Study the problems and the answers in Experiments 1 and 4.
 - a. What color beans appear in every answer?
 - b. What do you notice about each of the problems in Experiment 1?

- c. What do you notice about each of the problems in Experiment 4?
2. Study the problems and answers in Experiments 2 and 3.
 - a. What color beans appear in every answer?
 - b. What do you notice about each of the problems in Experiment 2?
 - c. What do you notice about each of the problems in Experiment 3?
3. Based on your observations, what rule could you create to help determine the sign of the product of TWO factors?

Part 3: Using Symbols to Replace Beans

DIRECTIONS: Because writing the words "white" and "red" is time consuming, symbols for the colors can be used. So that all students in your class will use the same symbols, a white bean will be represented by placing a negative (−) sign in front of a number. The symbol for red beans will be a positive (+) sign or no sign at all.

Example 1: Three white beans will be recorded as (-3).

Example 2: Four red beans will be recorded as (+4) or (4).

When using symbols to indicate multiplication, place the number of groups to be displayed first, then the number of beans that is to be in each group second. In these multiplication problems it is customary to place each of the numbers in parentheses or separate them by a "•". Use a minus sign (−) to indicate that groups of numbers are to be removed.

In the space to the right of each problem in Experiments 1–5, use symbols (+, −, •, =) to represent the problem and its answer.

Example 3: Show 3 groups of 2 red beans. $(3)(2) = 6$

Example 4: Remove 4 groups of 3 red beans. $(-4)(3) = -12$

Part 4: Applying What You Know

1. Based on the rule you developed in Part 2, predict ONLY THE SIGN of the answer for each of the following problems. Use your calculator to verify the results.

a. $\left(-\frac{1}{4}\right)\left(\frac{3}{4}\right) = \underline{\hspace{2cm}}$

d. $\left(5\frac{1}{2}\right)\left(-\frac{3}{16}\right) = \underline{\hspace{2cm}}$

b. $(-0.01)(-0.2) = \underline{\hspace{2cm}}$

e. $(-3)^2 = \underline{\hspace{2cm}}$

c. $(3.14)(2.02) = \underline{\hspace{2cm}}$

f. $(5)^2 = \underline{\hspace{2cm}}$

2. What will be sign of the product when three positive factors are multiplied together? Why?
3. What will be sign of the product when three negative factors are multiplied together? Why?
4. What will be sign of the product when two positive and one negative factor are multiplied together? Why?
5. What will be sign of the product when two negative and one positive factor are multiplied together? Why?
6. Based on the conclusions you reached in answering questions 2–5, predict ONLY THE SIGN of the answer to each of the following problems. Use your calculator to test your predictions.

a. $(-3)(-2)(-1) = \underline{\hspace{2cm}}$ d. $(4)(3)(5) = \underline{\hspace{2cm}}$

b. $(-2)(3)(4) = \underline{\hspace{2cm}}$ e. $(-2)^3 = \underline{\hspace{2cm}}$

c. $(5)(-2)(-5) = \underline{\hspace{2cm}}$ f. $(4)^3 = \underline{\hspace{2cm}}$

7. The rules for signs in division problems work the same as those in multiplication. Therefore what can you conclude about the sign of the quotient of...

- a. a positive divisor and a positive dividend?

b. a negative divisor and a negative dividend?

c. a positive divisor and a negative dividend?

d. a negative divisor and a positive dividend?

Test your theories by creating sample problems and entering them into your calculator.