

More on Minus

You will need

the Lab Gear



1. **Exploration** Choose several numbers and investigate the following questions. Write an explanation, using variables, of what you discover. What is the result when you
- add a number to its opposite?
 - subtract a number from its opposite?
 - multiply a number by its opposite?
 - divide a number by its opposite?

MINUS AND THE DISTRIBUTIVE LAW

For each problem below:

- Use the Lab Gear to model the first expression on the left side of the workmat.
 - If possible, simplify the expression by adding zero and removing matching blocks. Get all blocks downstairs.
 - Then decide which of the expressions a, b, c, or d is equal to the given expression. Setting up each one in turn on the right side of the workmat may help. Explain your answers.
- $x - (5 + 2x)$
 - $x - 5 + 2x$
 - $x - 5 - 2x$
 - $x + 5 + 2x$
 - $x + 5 - 2x$
 - $2x - (-4 + 3x)$
 - $2x - 4 + 3x$
 - $2x - 4 - 3x$
 - $2x + 4 + 3x$
 - $2x + 4 - 3x$
 - $3y + (5 - 2y)$
 - $3y - 5 + 2y$
 - $3y - 5 - 2y$
 - $3y + 5 + 2y$
 - $3y + 5 - 2y$
 - $x - (7 - 2y)$
 - $x - 7 + 2y$
 - $x - 7 - 2y$
 - $x + 7 + 2y$
 - $x + 7 - 2y$

- $6x - (-3 - x)$
 - $6x - 3 + x$
 - $6x + 3 + x$
 - $6x - 3 - x$
 - $6x + 3 - x$
- Write an equivalent expression without parentheses.
 - $2x^2 - (4 - x - x^2)$
 - $(2x^2 - 4) - (x - x^2)$
 - $(y - 5) - 3x - 2$
 - $y - 5 - (3x - 2)$
- Write an expression containing at least one pair of parentheses that is equivalent to the given expression. (Do not put parentheses around the whole expression, or around a single term.)

$$3x^3 - 6x + 2 - 5y$$
- Compare your answers to problem 8 with your classmates. Try to find several different correct answers.

A minus sign preceding parentheses tells you to subtract or take the opposite of everything in the parentheses. Writing an equivalent expression without parentheses is called *distributing the minus sign*.

- Summary** Explain how to distribute a minus sign. Use examples.
- Write an equivalent expression without parentheses.
 - $-(r + s)$
 - $-(-r + s)$
 - $-(r - s)$
 - $-(-r - s)$
- Write an equivalent expression without parentheses.
 - $-1(r + s)$
 - $-1(-r + s)$
 - $-1(r - s)$
 - $-1(-r - s)$

You can see from these problems that distributing a minus sign is really just distributing -1 .

ADDING THE OPPOSITE

Find the expression that must be added or subtracted. It may help to use the Lab Gear.

13. a. $3x^2 + (-5x) + \underline{\hspace{1cm}} = -(5x + x^2)$
 b. $3x^2 + (-5x) - (\underline{\hspace{1cm}}) = -(5x + x^2)$
14. a. $-2xy + x + \underline{\hspace{1cm}} = 6xy - 2x$
 b. $-2xy + x - (\underline{\hspace{1cm}}) = 6xy - 2x$
15. a. $-12 + 4yx + \underline{\hspace{1cm}} = 7xy - 15$
 b. $-12 + 4yx - (\underline{\hspace{1cm}}) = 7xy - 15$
16.  Compare your answers to parts (a) and (b) in problems 13-15. How are they related? Explain.
17. **Generalization** Problems 13-15 illustrated the following fact: *Subtracting is the same as adding the opposite.* For each subtraction, write an equivalent addition.
- a. $y - (-x)$

- b. $y - x$
 c. $-y - x$

18. Find the sign of the answer. (You do not need to find the answer.)
- a. $1646 - (-2459)$
 b. $-2459 - 1646$
 c. $-1646 - (-2459)$
 d. $2459 - (-1646)$
 e. $-1646 - (2459)$
19. Simplify each expression.
- a. $6 - (-5)$
 b. $-5 - (-7)$
 c. $-21 - (-3x) + 15$
 d. $-2x - (-12x) - 5xy$
20. Find each difference.
- a. $2y - 7y$ b. $3xy - (-2xy)$
 c. $-x^2 - 4x^2$ d. $2xy - 2x$

REVIEW AREA AND MULTIPLICATION

21. What is the other side of a rectangle, if one side is x and the area is
- a. $5x$?
 b. x^2 ?
 c. $x^2 + 2xy$?
 d. $x^2 + 2xy + 5x$?

The following equations are of the form *length times width = area of the rectangle*. Fill in the blanks. You may use the Lab Gear to help you. If you do, remember to use *upstairs* for minus and to build a figure with an *uncovered rectangle* of the required dimensions in the corner piece.

22. $x \cdot \underline{\hspace{1cm}} = xy - x^2$
23. $(y - 2) \cdot \underline{\hspace{1cm}} = 5y - 10$
24. $(\underline{\hspace{1cm}} - 3) \cdot x = 2xy - 3x$
25. $2x \cdot \underline{\hspace{1cm}} = 2xy + 4x^2 - 10x$
- Use the Lab Gear for these.
26. $(x + \underline{\hspace{1cm}})(y - 5) = xy + 5y - 5x - 2$
27. $(y - 1) \cdot \underline{\hspace{1cm}} = xy + 5y - x - 5$
28. $(y + 2)(y - 1) = \underline{\hspace{1cm}}$
 (Simplify.)
29.  $(y - 1) \cdot \underline{\hspace{1cm}} = y^2 + 4y - 5$
 (Hint: Study problem 28.)

DISCOVERY A SUBSTITUTION CODE

This message has been coded by a *simple substitution code*.

Rules:

- Each letter is always replaced by the same letter throughout the message.
- No letter is ever replaced by itself.

QEB NRIB CLN QEFP GFKA LC TLAB FP
 QEHQ BHTE IBQQBN FP HISHUP NBMI-
 HTBA OU QEB PHJB IBQQBN
 QENLRDELRO QEB JBPPHDB.

30.  Try to break the code. (Copy the message carefully, leaving blank space between the lines. If you have a guess for a letter, enter it every place that letter appears. For clarity, use lower-case letters for your solution, and capitals for the coded message. Use a pencil and an eraser. Hint: The first word is a very common three-letter word.)

PREVIEW MAKE A RECTANGLE

31.  For each problem make a Lab Gear rectangle having the given area. Write a multiplication equation.
- $x^2 + 9x + 8$
 - $x^2 + 6x + 8$