Algebra tiles provide students with the opportunity to “see” abstract algebraic expressions and equations with two variables. Regular use of algebra tiles will help students access abstract concepts through the use of concrete physical representations.

In the figures at right, the dimensions of each tile are shown along its sides, and the area is shown on the tile itself. Algebra tiles are named by their areas. For example, the $x^2$-tile is in the upper left corner; it has an area of $x^2$.

In algebraic expressions, combining terms that have the same area to write a simpler expression is called combining like terms.

For additional information, refer to the Math Notes box in Lesson A.1.1.

The Lesson A.1.1B Resource Page (available at cpm.org or in the eBook) provides algebra tiles for home use. An algebra tiles eTool is also available at cpm.org or in the eBook.

Example 1

Write a simplified algebraic expression for the tile collection below.

Solution:

\[
xy + x^2 + x + x + y^2 + 1 + x + y^2
\]

or

\[
x^2 + 2y^2 + xy + 3x + 1
\]

Example 2

The expression $x^2 + xy + y^2 + 3xy + y^2 + 7$ can be rewritten as $x^2 + xy + 3xy + y^2 + y^2 + 7$ and simplified to $x^2 + 4xy + 2y^2 + 7$ by combining like terms.

Example 3

\[
3x^2 - 4x + 3 + -x^2 + 3x - 7
\]

= $3x^2 - x^2 - 4x + 3x + 3 - 7$

= $2x^2 - x - 4$
An Expression Mat is a physical representation of an algebraic expression. The upper half of an expression mat is the positive (addition) region and the lower half is the negative (subtraction) region. Positive algebra tiles are shaded and negative tiles are blank. (The illustration to the right reminds you that shaded tiles are positive.) A matching pair of tiles with one tile shaded and the other tile blank represents two opposites—with a value of 0. We refer to them as “zero pairs.” (The Lesson A.1.1A Resource Page has an Expression Mat.)

On an Expression Mat, tiles may be removed or moved in one of two “legal” ways:

1. Flip tiles and move them from the negative region to the positive region. That is, change subtraction to adding the opposite.
2. Remove an equal number of opposite tiles (one shaded and one not shaded) that are within the same region. These pairs of opposite tiles have a value of zero.
3. Group tiles that are alike together. That is, combine like terms.

Example 4

Simplify $3x + 2 - (2x - 3)$.

Create Expression Mat:

Flip tiles in subtraction region to addition region:

Remove zero pairs:

Therefore, $3x + 2 - (2x - 3)$ simplifies to $x + 5$. 
Example 5

Simplify $1 - (2y - 3) + y - 2$. Create Expression Mat:

Flip tiles in subtraction region to addition region:

Remove zero pairs:

Therefore, $1 - (2y - 3) + y - 2$ simplifies to $2 + (-y)$ or $2 - y$.

Problems

Simplify each expression by combining like terms. Use algebra tiles if needed.

1. $2x^2 + x + 3 + 4x^2 + 3x + 5$
2. $y^2 + 2y + x^2 + 3y^2 + x^2$
3. $x^2 - 3x + 2 + x^2 + 4x - 7$
4. $y^2 + 2y - 3 - 4y^2 - 2y + 3$
5. $4xy + 3x + 2y - 7 + 6xy + 2x + 7$
6. $x^2 - y^2 + 2x + 3y + x^2 + y^2 + 3y$
7. $(4x^2 + 4x - 1) + (x^2 - x + 7)$
8. $(y^2 + 3xy + x^2) + (2y^2 + 4xy - x^2)$
Write the algebraic expression that corresponds to each Expression Mat, then simplify.

9. 

10. 

11. 

12. 

13. 

14. 

Use algebra tiles and an Expression Mat to simplify each expression.

15. \(3 + 5x - 4 - 7x\)

16. \(-x - 4x - 7\)

17. \(-(-x + 3)\)

18. \(4x - (x + 2)\)

19. \(5x - (-3x + 2)\)

20. \(x - 5 - (2 - x)\)

21. \(1 - 2y - 2y\)

22. \(-3x + 5 + 5x - 1\)

23. \(3 - (y + 5)\)

24. \(-(x + y) + 4x + 2y\)

25. \(3x - 7 - (3x - 7)\)

26. \(-(x + 2y + 3) - 3x + y\)

27. \((7x^2 - 6x - 9) - (9x^2 + 3x - 4)\)

28. \((3x^2 - 8x - 4) - (5x^2 + x + 1)\)
Answers

1. $6x^2 + 4x + 8$
2. $4y^2 + 2y + 2x^2$
3. $2x^2 + x - 5$
4. $-3y^2$
5. $10xy + 5x + 2y$
6. $2x^2 + 2x + 6y$
7. $5x^2 + 3x + 6$
8. $3y^2 + 7xy$
9. $3 + (-2) - 4 - (-3) = 0$
10. $3x + 1 - x - (-1) = 2x + 2$
11. $5 - (-2y) - (3) \text{ or } 5 - (-2y + 3) = 2y + 2$
12. $-4x - x - (-2) = -5x + 2$
13. $-(-2y) - 1 \text{ or } -(-2y + 1) = 2y - 1$
14. $3 + (-2y) - (-y) - (-2) = -y + 5$
15. $-2x - 1$
16. $-5x - 7$
17. $x - 3$
18. $3x - 2$
19. $8x - 2$
20. $2x - 7$
21. $-4y + 1$
22. $2x + 4$
23. $-y - 2$
24. $3x + y$
25. $0$
26. $-4x - y - 3$
27. $-2x^2 - 9x - 5$
28. $-2x^2 - 9x - 5$