# 5.1 Multiply Polynomials

**Student Text Pages**
210–219

**Suggested Timing**
70 min

**Tools**
- algebra tiles

**Technology Tools**
- computer
- *The Geometer's Sketchpad*®
- Algebra Tiles.gsp
- TI-89 calculator

**Related Resources**
- BLM 5–3 Section 5.1 Practice Master
- T–4 *The Geometer's Sketchpad*® 3
- T–5 *The Geometer's Sketchpad*® 4
- T–7 The Computer Algebra System (CAS) on the TI-89 Calculator
- A–8 Application General Scoring Rubric

**TI-Navigator™**

Go to **www.mcgrawhill.ca/books/principles10** and follow the links to the file for this section.

## Teaching Suggestions

- Discuss the opening scenario and the fact that algebra can be used to model quantities such as dimensions and area. (5 min)

### Investigate

- In **Investigate A**, have students work through either method of multiplying polynomials. The methods use algebra tiles or virtual algebra tiles (*The Geometer's Sketchpad*®) because students learn best from hands-on and visual approaches. It will also help them understand factoring, beginning in Section 5.3. Students often know the mechanics of multiplying polynomials, but algebra tiles provide deeper understanding of the topic. Use **T–4 *The Geometer's Sketchpad*® 3** and **T–5 *The Geometer's Sketchpad*® 4** to support this activity. (30 min)
- If CAS is available, **Investigate B** can enhance learning as well. Use **T–7 The Computer Algebra System (CAS) on the TI-89 Calculator** to support this activity. (20 min)

### Examples

- Present **Example 1**, which consolidates what was developed in the Investigations. Use a diagram, such as in Method 2, to illustrate for the visual learners. (5 min)
- **Examples 2** and **3** develop a procedure for expanding a product of two binomials. Arrows help remind students that four terms occur in the initial expansion. Remind students what is meant by "like terms." (10 min)

### Communicate Your Understanding

- Have students answer the questions in this section, then discuss their answers as a class. Questions C1 and C2 are keys to communicating understanding. (10 min)
- A note on using algebra tiles: Unless you are an expert at algebra tiles, it is recommended that you limit their use to positives only. Negative tiles and subtraction involve laying the negative tile on top of another tile and can be confusing to students. Algebra tiles should be used as a bridge between concrete representation and abstract understanding.
- Use **BLM 5–3 Section 5.1 Practice Master** for remediation or extra practice.

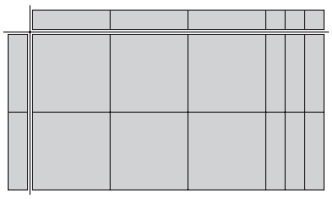
## Investigate Answers (pages 210–213)

### A

### Method 1

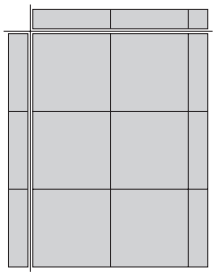
**1.** Six $x$-tiles are needed to fill in the rectangle.
area of the rectangle: $6x^2$
product: $(2x)(3x) = 6x^2$

**2. a)**



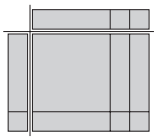
**b)** Six $x^2$-tiles and six $x$-tiles are needed to fill in the rectangle.
product: $(2x)(3x + 3) = 6x^2 + 6x$

**3.**



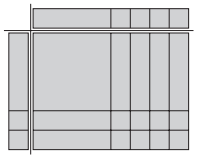
$(3x)(2x + 1) = 6x^2 + 3x$

**4. a)**



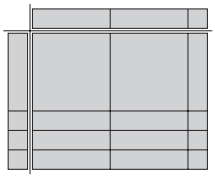
$(x + 1)(x + 2) = x^2 + 3x + 2$

**b)**



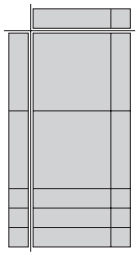
$(x + 2)(x + 4) = x^2 + 6x + 8$

**c)**



$(x + 3)(2x + 1) = 2x^2 + 7x + 3$

**d)**



$(2x + 3)(x + 1) = 2x^2 + 5x + 3$

**5. a)** Model the binomials as dimensions of a rectangle. Fill in the rectangle to find the product of the binomials.

**b)** Answers will vary.

$$(ax + b)(cx + d) = acx^2 + adx + bcx + bd$$
$$= acx^2 + (ad + bc)x + bd$$

**6. a)** $(x + 3)(x + 8) = x^2 + 11x + 24$

**b)** $(2x + 5)(x + 4) = 2x^2 + 13x + 20$

**c)** $(4x + 7)(3x + 1) = 12x^2 + 25x + 7$

### Method 2

**1.** Six $x$-tiles are needed to fill in the rectangle.
area of the rectangle: $6x^2$
$(2x)(3x) = 6x^2$

**2. c)** Six $x^2$-tiles and six $x$-tiles are needed to fill in the rectangle.
product: $(2x)(3x + 3) = 6x^2 + 6x$.

**3.** $(3x)(2x + 1) = 6x^2 + 3x$

**4. a)** $(x + 1)(x + 2) = x^2 + 3x + 2$
**b)** $(x + 2)(x + 4) = x^2 + 6x + 8$
**c)** $(x + 3)(2x + 1) = 2x^2 + 7x + 3$
**d)** $(2x + 3)(x + 1) = 2x^2 + 5x + 3$

**5. a)** Model the binomials as dimensions of a rectangle. Fill in the rectangle to find the product of the binomials.
**b)** Answers will vary.

$$(ax + b)(cx + d) = acx^2 + adx + bcx + bd$$
$$= acx^2 + (ad + bc)x + bd$$

**6. a)** $(x + 3)(x + 8) = x^2 + 11x + 24$
**b)** $(2x + 5)(x + 4) = 2x^2 + 13x + 20$
**c)** $(4x + 7)(3x + 1) = 12x^2 + 25x + 7$

### B

**2.** $2x(3x - 5) = 6x^2 - 10x$

**3.** $2x(3x) + 2x(-5) = 6x^2 - 10x$

**4.** The answers are the same. Answers will vary.

**5. a)** $2x(5x^2 - 3x + 1) = 10x^3 - 6x^2 + 2x$
**b)** $-3x^2(2x^2 + 5x - 3) = -6x^4 - 15x^3 + 9x^2$
**c)** $3xy(2x^2y - 4xy^2) = 6x^3y^2 - 12x^2y^3$
**d)** $ax(bx - cy + d) = abx^2 - acxy + adx$

**6. a)** $2x(5x^2) + 2x(-3x) + 2x(1) = 10x^3 - 6x^2 + 2x$
**b)** $(-3x^2)(2x^2) + (-3x^2)(5x) + (-3x^2)(-3) = -6x^4 - 15x^3 + 9x^2$
**c)** $3xy(2x^2y) + 3xy(-4xy^2) = 6x^3y^2 - 12x^2y^3$
**d)** $ax(bx) + ax(-cy) + ax(d) = abx^2 - acxy + adx$

**7. a)** $(x + 1)(x + 2) = x^2 + 3x + 2$
**b)** $(x + 2)(x + 4) = x^2 + 6x + 8$
**c)** $(x + 3)(2x + 1) = 2x^2 + 7x + 3$
**d)** $(2x + 3)(x + 1) = 2x^2 + 5x + 3$

**8. a)** $x(x + 2) + 1(x + 2) = x^2 + 3x + 2$
**b)** $x(x + 4) + 2(x + 4) = x^2 + 6x + 8$
**c)** $x(2x + 1) + 3(2x + 1) = 2x^2 + 7x + 3$
**d)** $2x(x + 1) + 3(x + 1) = 2x^2 + 5x + 3$

**9.** Answers will vary.

$$(ax + b)(cx + d) = acx^2 + adx + bcx + bd$$
$$= acx^2 + (ad + bc)x + bd$$

### Communicate Your Understanding Responses (page 217)

**C1.** The dimensions of the rectangle are $x + 1$ (which is shown by the $x$-tile and unit tile) and $3x + 2$ (which is shown by three $x$-tiles and two unit tiles). The product is the area of the rectangle. The product is $3x^2 + 5x + 2$.

**C2. a)** Jason is figuring out how many $x$-tiles he will need for the area, which is $3 + 7$, and then figuring out how many unit tiles he will need, which is $3 \times 7$. Then he still needs one $x^2$-tile.
**b)** No, because there are coefficients in front of the $x$-terms. He will need to use $(2)(5)$ $x^2$-tiles, $((2)(6) + (3)(5))$ $x$-tiles, and $(3)(6)$ unit tiles.
**c)** Answers will vary. For example: Yes, just add or multiply with the value of the integers, whether they are positive or negative.

**C3.** $(3x)(2x) = 6x^2$, $(3x)(-9) + (5)(2x) = -17x$, and $(5)(-9) = -45$. The answer will be $6x^2 - 17x - 45$.

**C4.** FOIL means multiply the First terms in each binomial, then multiply the Outside terms in each binomial, then multiply the Inside terms of each binomial, then multiply the Last terms in each binomial.

## Common Errors

- Some students may multiply only the first terms and the last terms, neglecting the full distributive property.

**$R_x$** Have students use four arrows to illustrate visually how four terms should result after multiplying.

- Some students may have difficulties with the signs when expanding the brackets.

**$R_x$** Have students colour the operations in red as a reminder to include the signs in the expansion.

## Accommodations

**Gifted and Enrichment**—Challenge students to create a complex two-dimensional figure where the side lengths of the figure are algebraic expressions, to write the algebraic expression for the area of the figure in more than one way, and then to expand and simplify both of the expressions to determine the area of the figure.

**Perceptual**—Allow students to use a vertical format to find a binomial product. For example:

$$\begin{array}{r} x+2 \\ \times\quad x+3 \\ \hline 2x+6 \\ x^2+2x \\ \hline x^2+4x+6 \end{array}$$

**Language**—Encourage students to work together on questions in which algebraic expressions are used to communicate mathematical ideas.

**Memory**—Allow students to use algebra tiles or diagrams to model binomial products.

**ESL**—Allow students to use their dictionaries or translators to understand the new words in this section.

## Student Success

Use a matching game to identify equivalent pairs of expressions (pre- and post-expansion).

## Practise

- **Question 1** is especially useful for visual learners.
- **Questions 3** through **5** focus on changes in operations between the terms of the binomials and should all be assigned.
- **Questions 6** through **8** combine types of polynomials. Assign a selection of these questions.
- **Question 9** discusses a familiar application of a projectile.
- **Question 12** offers a good connection between parabolas in Chapter 4 and Chapter 5.
- **Question 14** offers a good opportunity to develop more abstract thinking, with variables used entirely for the dimensions, and changes in dimension, of a cube. Students may have difficulty with parts d) and e). Remind students how the difference between two polynomials is handled with brackets. Use **A–8 Application General Scoring Rubric** when assessing students.
- In **question 16**, most students will divide the diagram into two parts. The diagrams can also be redrawn by completing a larger rectangle and subtracting the area of the unshaded region.
- In **question 18**, give students a hint that the pattern can be expressed as a difference or sum of two other, smaller patterns.

## Literacy Connections

Discuss the Literacy Connections on page 216 with students. Ask students if they can think of any other words or phrases that mean to "expand."

Create a Word Wall for this chapter. Include "expand" and "simplify" on the Word Wall.

## Mathematical Processes Integration

The table shows questions that provide good opportunities for students to use the mathematical processes.

| Process Expectations | Selected Questions |
|---|---|
| Problem Solving | 18 |
| Reasoning and Proving | 18 |
| Reflecting | 9, 12, 16, 17, |
| Selecting Tools and Computational Strategies | 16, 18 |
| Connecting | 9, 10–15, 17 |
| Representing | 1, 2, 10–14, 16, 18 |
| Communicating | 19 |

## Ongoing Assessment

- Communicate Your Understanding questions can be used as quizzes to assess students' communication skills.