# 3.4 Communicate With Algebra

**Strand:**
Number Sense and Algebra

**Student Text Pages**
130 to 139

**Suggested Timing**
80 min

**Tools**
- algebra tiles

**Technology Tools**
- *The Geometer's Sketchpad®*
- computers
- graphing calculators

**Related Resources**
BLM A5 Problem Solving Checklist
BLM A18 My Progress as a Problem Solver
BLM 3.4.1 Practice: Communicate With Algebra
BLM A9 Communication General Scoring Rubric
BLM A7 Thinking General Scoring Rubric
BLM T4 *The Geometer's Sketchpad®* 3
BLM T5 *The Geometer's Sketchpad®* 4
BLM 3.4.2 Achievement Check Rubric
BLM 3.4.3 Student Success: Crossword

**Mathematical Process Expectations Emphasis**

- ☑ Problem Solving
- ☐ Reasoning and Proving
- ☐ Reflecting
- ☐ Selecting Tools and Computational Strategies
- ☐ Connecting
- ☑ Representing
- ☑ Communicating

## Specific Expectations

**Manipulating Expressions and Solving Equations**

**NA2.04** add and subtract polynomials with up to two variables [e.g., $(2x - 5) + (3x + 1)$, $(3x^2y + 2xy^2) + (4x^2y - 6xy^2)$], using a variety of tools (e.g., algebra tiles, computer algebra systems, paper and pencil);

### Link to Get Ready

Understanding of all of the concepts in the Get Ready section is required by this point. Ensure that students have completed all of the Get Ready questions prior to working on this section.

## Teaching Suggestions

- Example 1 highlights the distinction between coefficients and variables, using contextual references. This understanding is critical as it prepares students for algebraic operations, such as collecting like terms. The specific examples have been carefully selected to address some of the common misunderstandings.
- Use the comments column to discuss these issues with the class, and provide additional examples to illustrate, as needed.
- The focus of Examples 2, 3, and 4 is on classifying terms and polynomials. Understanding the degree of a polynomial is important when working with linear and non-linear relations, which students will do later in this course and in future mathematics courses.
- Example 5 applies basic algebraic concepts to model and solve a contextual problem. A general algebraic expression is set up, into which values are substituted in order to solve for a particular case. Point out to students that that the algebraic expression is useful in a number of particular situations. Explain that these expressions are sometimes referred to as "formulas." You may wish to use **BLM A5 Problem Solving Checklist** to help you in assessing your students. Alternatively, have students use **BLM A18 My Progress as a Problem Solver** as a self-assessment tool.
- You may wish to use **BLM 3.4.1 Practice: Communicate With Algebra** for extra practice or remediation.

**Communicate Your Understanding Responses (page 134)**

**C1. a)** Answers will vary. A sample answer: $5a$; $8t$
**b)** Answers will vary. A sample answer: $13d + 7$; $x - 5$
**c)** Answers will vary. A sample answer: $7s^2 + 3s + 2$; $x^2 + 3x - 1$
**d)** Answers will vary. A sample answer: $6x^3 + 3x^2 + 8x + 1$; $a^3 + 2a^2 - a^2 + 3$

**C2.** No, the variable is $x^2$, the coefficient is 1. The degree of the polynomial is 2.

**C3. a)** Yes, the expressions are the same. The coefficient 1 does not have to be written if it goes with a variable.
**b)** No, the expressions are not equivalent. The second expression has a constant of 1 added to the term $3x$.
**c)** You must write the coefficient 1 when it is a constant but not when it is part of a term.

## Common Errors

- Some students may misidentify a missing coefficient as zero, instead of 1.

**$R_x$** Use algebra tiles to model expressions such as $x$. Remind students to think: there is one tile, so the coefficient is 1.

- Some students may misidentify a missing exponent on a variable as zero, instead of 1.

**$R_x$** Use a pattern of powers in expanded form to illustrate that the exponent of $x$ is 1:
$x^3 = x \times x \times x$
$x^2 = x \times x$
$x^1 = x$

- Some students may confuse monomial, binomial, trinomial, etc.

**$R_x$** Have students look for addition and subtraction operators, which separate terms. Refer to the margin tip in Example 2.

- Some students may struggle in setting up algebraic expressions to model given information.

**$R_x$** Have students consider whether a part of an expression is fixed or can vary. This will suggest whether or not a variable is required. Looking for key words such as total, less, etc., can suggest whether terms should be added or subtracted, etc. Have students work in pairs on some of the Connect and Apply questions. Consider providing remedial work on writing algebraic expressions. Use **BLM 3.4.1 Practice: Communicate With Algebra.**

## Ongoing Assessment

- Use Achievement Check question 17 to monitor student success. See Achievement Check Answers and **BLM 3.4.2 Achievement Check Rubric**.
- Chapter Problem question 16 can also be used as an assessment tool.
- Communicate Your Understanding questions can be used as quizzes to assess students' Communication skills (see **BLM 3.4.2 Achievement Check Rubric** for levels).

## Practise

Caution students about the presence of "invisible 1s," for example:
- $x^2$ has a coefficient of 1, not zero
- $3y$ has degree 1, not zero
- however, $-4$ has degree zero, not 1.

## Connect and Apply

For question 9, remind students to use brackets when substituting into algebraic expressions to ensure that proper operations are applied.

For question 10, remind students how to convert a percent to a decimal.

Make algebra tiles available for question 14. Some students may benefit from starting with the tiles and developing the expression from them.

Questions 10–13, 16, and 17 require students to set up algebraic expressions based on given information in prose form. Many students struggle with this skill. Consider having students work with a partner on some of these questions, and/or discuss one or two questions as a class to help build confidence.

For question 15, you may wish to use **BLM A9 Communication General Scoring Rubric** to assist you in assessing your students.

For question 17, you may wish to use **BLM A7 Thinking/General Scoring Rubric** to assist you in assessing your students.

**Achievement Check Answers (page 137)**

**17. a)** $3w + 2l + t$

**b)** $w$ represents the number of wins; $l$ represents the number of losses; and $t$ represents the number of ties

**c)** $3(5) + 2(2) + 3 = 22$

**d)** The Falcons could have had 6 wins, 0 losses, and 4 ties. $3(6) + 2(0) + 4 = 22$

## Extend

For question 18, the trinomial will involve fractions, and so may look intimidating. Use the swim time as an example for generating the rest of the expression. After substituting values in part d), students need to divide each distance by speed to find the times for each leg of the race, before adding. Have students use *The Geometer's Sketchpad*® for question 20, which is a particularly useful tool when examining part c). Use **BLM T4 T*he Geometer's Sketchpad*® 3 or BLM T5 *The Geometer's Sketchpad*® 4** for this activity. For enrichment, capable students can generate and examine the functional relationship between distance walked and total travel time, which can be easily produced using *The Geometer's Sketchpad*®. A graphing calculator can also be used, but lacks click-and-drag capabilities. Optimization (in this case finding the minimum travel time) is an important skill that will continue to be developed right into university level calculus courses.

Question 21 requires the use of multi-variable (for example, $x$ and $y$) tiles. Alternatively, students can adjust the representation of their existing tile set (for example, let the $x$-tile represent the value of the plane, and let the $x^2$-tile represent the number of seats). This idea of creatively bending an existing model to address a particular problem should be encouraged and extended. For example, ask students, *What tools are available that you can use to build a model to suit your purpose?*

## Accommodations

**Language**—Encourage students to work together when working through the questions where algebraic expressions are used to communicate mathematical ideas.

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

## Student Success

Use **BLM 3.4.3 Student Success: Crossword** to help students with the vocabulary in this chapter.

## Literacy Connections

There is a heavy emphasis on mathematical literacy in this section. There are a number of effective strategies that can be used to help students achieve clearer understanding of the various terms and concepts, such as Frayer models and word walls. For more information on these and other good strategies, refer to the Ontario Association for Mathematics Education's *Think Literacy: Mathematics Approaches Grades 7–12*, available for order or download at: http://oame.on.ca/main/index1.php?lang=en&code=ThinkLit.

## Exercise Guide

| Category | Question Number |
|---|---|
| Minimum (essential questions for all students to cover the expectations) | 1–12 |
| Typical | 1-4, 5a), c), e), 6a), c), e), 7-16 |
| Extension | 18–24 |

# Use Technology

# Virtual Algebra Tiles With *The Geometer's Sketchpad®*

**Strand:**
Number Sense and Algebra

**Student Text Pages**
140 to 143

**Suggested Timing**
40–80 min

**Technology Tools**
- *The Geometer's Sketchpad®*
- computers
- Algebra Tiles.gsp

**Related Resources**
BLM T4 *The Geometer's Sketchpad®* 3

BLM T5 *The Geometer's Sketchpad®* 4

BLM A10 Observation Assessment General Scoring Rubric

**Accommodations**

**Motor**—Give students extra time to work through this section. Encourage students to practise using *The Geometer's Sketchpad®* on their home computers.

**ESL**—Encourage students to work in pairs to understand the instructions to use *The Geometer's Sketchpad®*.

## Specific Expectations

**Operating With Exponents**

**NA1.02** describe the relationship between the algebraic and geometric representations of a single-variable term up to degree three [i.e., length, which is one dimensional, can be represented by $x$; area, which is two dimensional, can be represented by $(x)(x)$ or $x^2$; volume, which is three dimensional, can be represented by $(x)(x)(x)$, $(x^2)(x)$, or $x^3$];

**Manipulating Expressions and Solving Equations**

**NA2.04** add and subtract polynomials with up to two variables [e.g., $(2x - 5) + (3x + 1)$, $(3x^2y + 2xy^2) + (4x^2y - 6xy^2)$], using a variety of tools (e.g., algebra tiles, computer algebra systems, paper and pencil);

### Warm-Up

Review and/or make available physical algebra tiles (unit tiles, $x$-tiles, and $x^2$-tiles) for comparison with virtual tiles.

## Teaching Suggestions

- Virtual algebra tiles work in basically the same way as physical tiles, except you can actually vary the length of the variable tiles. Conduct a class discussion on the relative advantages and disadvantages of the various models.
- Allow students the opportunity to see as many different representations of algebraic concepts as possible, for example, physical tiles, virtual tiles, symbolic representation, Computer Algebra System representation. Algebra is one of the most important, and yet most abstract, branches of secondary mathematics. By exposing students with diverse learning styles to a multitude of representations, there is a better chance that they will understand key concepts.
- In questions 7 and 8, the rectangles that students are to build are useful conceptually later in the chapter, and in future mathematics courses, when students explore the distributive property and polynomial factorization.
- You may wish to use **BLM T4 *The Geometer's Sketchpad®* 3** or **BLM T5 *The Geometer's Sketchpad®* 4** for this activity.
- You may wish to use **BLM A10 Observation Assessment General Scoring Rubric** to assist you in assessing your students.