# Formulating algebraic expressions

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| Year level  Strand(s)  Lesson length  CD Code: | 7  Algebra  60 mins  [AC9M7A01](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7A01&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M7A02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7A02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Lesson summary | In this lesson introduce the concept of variables using physical materials and explore the construction of algebraic expressions in authentic contexts.  This is the first lesson in a series of lessons to develop understandings and proficiency in algebraic thinking. |
| Learning intention | We are learning to revise the order of operations, and its importance, with integers.  We will connect number rules/properties to algebraic conventions.  We formulate algebraic expressions from word problems. |
| Success criteria | By the end of this lesson, students can:  formulate algebraic expressions from word problems  explain what a variable is  explain how number rules/properties connect to algebraic conventions. |
| Why are we learning about this? | Often in mathematics it is useful to have a way to represent values that we do not yet know, for example, someone might want to figure out what discount was applied to their purchase. We can easily solve problems like this using algebra, where we represent unknown values using variables. It gives us a way of recording mathematical thinking. Once represented as formulas and expressions, it is easier to consider the next mathematical steps to solving the question. Sometimes people also need to model situations where a value might change under different circumstances. We use algebra to solve numerous mathematical problems in the real world. |
| Prerequisite student knowledge and language | Prior to this lesson, it is assumed that students have knowledge of:   * conventions associated with the order of operations for integers * addition, subtraction, multiplication and division facts and strategies. * It is also useful if students have an understanding that ‘=’ indicates an equivalence statement. |
| **Resources** | * Teacher’s slides (PowerPoint) * Working with algebra worksheet (Word) * Decimats worksheet (Word) * Mini-whiteboards or A3 blank paper |

Curriculum information

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| Achievement standard | Students use algebraic expressions to represent situations. |
| Content description(s) | Students recognise and use variables to represent everyday formulas algebraically and substitute values into formulas to determine an unknown. [AC9M7A01](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7A01&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Students formulate algebraic expressions using constants, variables, operations and brackets. [AC9M7A02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7A02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| General capabilities  Cross-curriculum priority | Numeracy:  Number patterns and algebraic thinking ([Level 6](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7A01&general-capability-code=N&element-code=NN&sub-element-index=0&sub-element-code=NNNPA&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))  Critical and Creative Thinking:  interpret concepts and problems ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7A02&general-capability-code=N&element-code=NN&sub-element-index=0&sub-element-code=NNNPA&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) |
| Areas of challenge | Some students may:  consider that the ‘=’ sign indicates to record an example, rather than expressing an equivalence relationship  think that a variable represents the count for the number of objects (for example, 3a means 3 apples)  have difficulties understanding the lack of multiplication signs in algebraic expressions, such as  have difficulties with different decimal and fraction representations in algebraic expressions, such as  think that a particular variable always holds the same value  think that the same variable in an expression can hold different values, such as thinking that *t* could be 2 and 4 in the expression . |
| Strategies | [Explicit teaching](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/explicit-teaching/)  [Concrete, Representational, Abstract (CRA)](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/concrete-representational-abstract-cra/)  [Collaborative learning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/collaborative-learning/) |

Lesson structure

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| Learning hook  20 mins | **Note:** Download the teacher’s slides with teaching notes to use alongside this lesson. Show the slides on the board for students to follow as the lesson progresses.  **Introduction**   * (Slides 2–5) Introduce the learning intention, why we learn algebra and the skill check. Use a few minutes to go through ‘order of operations’ example questions of your making or use a link to numerous interactive websites. A useful site is [Geogebra: order of operations](https://www.geogebra.org/m/v2yquh6e). Ask questions such as, ‘Which values do we operate on next and why? How did we get from that line of working to the next? How do you know that for sure? What if we did … instead of …?’ Conclude the warm-up activity by asking students to reflect on the importance of order of operations and why they matter.   **Differentiation** (enable): Ensure students are supported as examples are gone through by recording each line of working on the board.  **Differentiation** (engage): To extend students while reflecting on the question above, they can be provided with the example question , which is an ambiguous question that could be written clearer.  **The hook**   * Project slide 6 and explain to students that this image is representing a balance scale where each side is ‘equivalent’ (equal to) the other. Allow the class to think-pair-share about what you might replace the red question mark with. Allow pairs of students to share their answer and approaches. * Project the image on slide 7 and ask students to consider the specific weights assigned to the phones and laptop. Ask students to work in pairs to construct a number sentence for each scale. (For the second scale, with ‘?’, have each pair use their answer from the first scale.) The answers are animated and show up on the slide when you click the mouse. * Go to slide 8 and propose to students that sometimes ‘weight’ is unknown and that sometimes there are a variety of weights involved (phone and computer). We could write our number sentences like those showed in the slide. * Explain that in mathematics it isn’t always easy to continue to write or draw icons when we are representing an unknown value. Therefore, we use symbols (typically letters of the alphabet) for a value that we don’t know yet. We could call the weight of the phone and the weight of the laptop Show slide 9.   Following this, ask each student to fold one page of their book into three columns (or use a piece of A4 paper). At the top of each column, record the titles as shown in slide 10. Alternatively, print and hand out the Working with algebra worksheet. |
| Explore  30 mins | **Note:** Pre-prepare cups, and counters in two different colours (green and red used here), or edit the lesson and slides to suit you. Print out the Decimats worksheet for students to use (slides 11–12).   * Tell students that we will represent a variable using a cup (one cup is equal to one of the variables, for example, 1) and represent numbers using counters (one green counter is equal to +1 and one red counter equals –1) on an algebra mat. Model an example of constructing the following expression using the cups and counters along with the accompanying symbolic expression:   ‘Honey gets $3 more pocket money than her brother Liam. Construct an expression to show how much money Honey gets.’  Answer: Let the amount of money Liam gets be represented by the cup.   * Model the solution to a second question involving negative values (one red counter is equal to –1):   ‘Pria is 2 years younger than her sister Pari. Construct an expression to show how old Pria is.’  Answer: Let Pari’s age be represented by the cup.   * In groups of three or four, allow students to work through the questions on the worksheet. For each question, the students should model the expression on the algebra mat with cups and counters and draw their cups and counters representation and record the accompanying algebraic expression on the worksheet.   **Differentiation:** Questions are scaffolded in difficulty, allowing the teacher to differentiate how many questions each group of students are expected to complete. |
| Summary and reflection  10 mins | **Bring key ideas together and stimulate reflection**   * Explain to students that to end the lesson you are playing a game called ‘mystery number’ (slide 13). In this game, students can pick any mystery number they like, then follow the set of operations you will tell them: ‘You’re thinking of a mystery number that I am going to guess. With your mystery number, first I want you to double it. Then subtract 2. Then add 3. From that result, subtract your mystery number twice. And subtract 1.’ * Pause before saying, your answer is 0! * Once students have seen that you have guessed their answer, ask students, in groups of three or four, to brainstorm how you were able to construct the expression. Provide paper or mini-whiteboards for recording brainstorming thoughts.   Answer for teachers:   * To conclude the group exploration of the mystery number, ask for students to contribute to a whole-class discussion responding to the prompt: ‘How was your knowledge of constructing algebraic expressions useful in solving the mystery of the mystery number?’ Slide 14 introduces the exit ticket. |
| Assessment | The following formative assessment is suggested for this lesson.  Have students complete their Decimats worksheet as homework to be handed in for you to assess and reflect on each student before proceeding to the following lesson, ‘Expressions, formulas and substitution’.  Ask students to record on their Decimat worksheet how well they felt they understood the lesson about constructing algebraic expressions (for example, by circling the ☺, 😐 or ☹ face on their exit ticket). |