Mathematics Stage 5 (Year 10) – unit of learning

Expressions and equations

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# Rationale

The NSW Department of Education publishes a range of curriculum support materials, including samples of lesson sequences, scope and sequences, assessment tasks, examinations, student and teacher resource booklets, and curriculum planning and curriculum evaluation templates. The samples are not exhaustive and do not represent the only way to complete or engage in each of these processes. Curriculum design and implementation is a dynamic and contextually-specific process. While the mandatory components of syllabus implementation must be met by all schools, it is important that the approach taken by teachers is reflective of their needs, and faculty or school processes.

The NSW Education Standards Authority (NESA) defines [programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming) as ‘the process of selecting and sequencing learning experiences which enable students to engage with syllabus outcomes and develop subject specific skills and knowledge’ (NESA 2022). A program is developed collaboratively within a faculty. It differs from a unit in important ways, as outlined by NESA on their [Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units) page. A unit is a contextually-specific plan for the intended teaching and learning for a particular class for a particular period. The organisation of the content in a unit is flexible and it may vary according to the school, the teacher, the class and the learning space. They should be working documents that reflect the thoughtful planning and reflection that takes place during the teaching and learning cycle. There are mandatory components of programming and unit development, and this template provides one option for the delivery of these requirements. The NESA and department guidelines that have influenced this template are elaborated upon at the end of the document.

This resource has been developed to assist teachers in NSW Department of Education schools to create learning that is contextualised to their classroom. It can be used as a basis for the teacher’s own program, assessment, or scope and sequence, or be used as an example of how the new curriculum could be implemented. The resource has suggested timeframes that may need to be adjusted by the teacher to meet the needs of their students.

# Overview

**Description**: this program of learning addresses content from the focus areas of Algebraic techniques A, Equations A, Algebraic techniques B, and Equations C. The lessons and sequences in this program of learning are designed to allow students to explore operating with algebraic expressions and equations.

**Duration**: this program of learning is designed to be completed over a period of approximately 3–4 weeks but can be adapted to suit the school context.

**Explicit teaching**: suggested learning intentions and success criteria are available for some lessons provided. Learning intentions and success criteria are most effective when they are contextualised to meet the needs of students in the class. The examples provided in this document are generalised to demonstrate how learning intentions and success criteria could be created.

# Outcomes

## Core

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* simplifies algebraic fractions with numerical denominators and expands algebraic expressions **MA5-ALG-C-01**
* solves linear equations of up to 3 steps, limited to one algebraic fraction **MA5-EQU-C-01**

## Path

* simplifies algebraic fractions involving indices, and expands and factorises algebraic expressions **MA5-ALG-P-01**
* solves linear equations of more than 3 steps, monic and non-monic quadratic equations, and linear simultaneous equations **MA5-EQU-P-02**

The identified Life Skills outcomes that relate to this unit are **MALS-PAT-01** – recognises and applies patterns in everyday contexts, **MALS ADS 01** – uses strategies for addition and subtraction and **MALS-DMI-01** – uses strategies for multiplication and division.

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**Prior to planning for teaching and learning, please consider the following**:

**Engagement**

* How will I provide authentic, relevant learning opportunities for students to personally connect with lesson content?
* How will I support every student to grow in independence, confidence, and self-regulation?
* How will I facilitate every student to have high expectations for themselves?
* How will I identify and provide the support each student needs to sustain their learning efforts?

**Representation**

* What are some different ways I can present content to enable every student to access and understand it?
* How will I identify and address language and/or cultural considerations that may limit access to content for students?
* How will I make lesson content and learning materials more accessible?
* How will I plan learning experiences that are relevant and challenging for the full range of students in the classroom?

**Expression**

* How will I provide multiple ways for students to respond and express what they know?
* What tools and resources can students use to demonstrate their understanding?
* How will I know every student has understood the concepts and language presented in each lesson?
* How will I monitor if every student has achieved the learning outcomes and learning growth?

# Lesson sequence and details

## Learning episode 1 – the power of one

### Teaching and learning activity

Students use Amplify’s Polypad to investigate adding and subtracting fractions. They use this knowledge to apply to adding and subtracting algebraic fractions.

### Syllabus content

* Simplify expressions that involve algebraic fractions with numerical denominators
* Simplify expressions that involve operations with algebraic fractions, including algebraic fractions that involve pronumerals in the denominator and/or indices (Path)

Table 1 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [The power of one (DOCX 730 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l01-the-power-of-one.docx)Duration**:** 1 lessonLearning intention* To be able to simplify expressions that involve the addition or subtraction of algebraic fractions.

Success criteria* I can identify factors of numbers.
* I can add or subtract fractions with an uncommon denominator.
* I can add or subtract fractions with a variable in the numerator.
* I can add or subtract fractions with a variable in the denominator.
 | * [*The power of one* (PPTX 2.4 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l01-the-power-of-one-slideshow.pptx) PowerPoint
* Digital device per pair of students
* Appendix A, printed (one copy per pair)
* Appendix B (teacher copy only)
* Appendix C, printed (one copy per group of 3)
* Appendix D, printed and cut into individual cards
 |  |

## Learning episode 2 – multiplying multiple ways

### Teaching and learning activity

Students explore multiplying fractions that give a result of one. Students use this knowledge to develop how to simplify algebraic fractions when multiplying 2 terms, including those with variables in the numerator and denominator.

### Syllabus content

* Simplify expressions that involve algebraic fractions with numerical denominators
* Simplify algebraic fractions, including those involving indices (Path)
* Simplify expressions that involve operations with algebraic fractions, including algebraic fractions that involve pronumerals in the denominator and/or indices (Path)

Table 2 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Multiplying multiple ways (DOCX 384 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l02-multiplying-multiple-ways.docx)Duration**:** 1 lessonLearning intention* To be able to simplify expressions that involve the multiplication of algebraic fractions.

Success criteria* I can write a fraction that is equivalent to one.
* I can simplify fractions that contain variables in the numerator and denominator.
* I can explain the most efficient method to simplify an expression.
 | * [*Multiplying multiple ways* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l02-multiplying-multiple-ways-slideshow.pptx) PowerPoint
* Digital device per pair of students
* Appendix A, printed in A3 (one per group of 3)
* Appendix B, C and D, printed (one per student)
 |  |

## Learning episode 3 – divide and conquer

### Teaching and learning activity

Students explore how to divide fractions using bar models and progress into algebraic fractions, proving why we multiply by the reciprocal.

### Syllabus content

* Simplify expressions that involve algebraic fractions with numerical denominators
* Simplify algebraic fractions, including those involving indices (Path)
* Simplify expressions that involve operations with algebraic fractions, including algebraic fractions that involve pronumerals in the denominator and/or indices (Path)

Table 3 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Divide and conquer (DOCX 524 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l03-divide-and-conquer.docx)Duration**:** 1–2 lessonsLearning intention* To be able to simplify expressions that involve the division of algebraic fractions.

Success criteria* I can divide fractions using bar models.
* I can demonstrate why multiplying by the reciprocal works when dividing fractions.
* I can divide algebraic fractions.
 | * [*Divide and conquer* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l03-divide-and-conquer-slideshow.pptx) PowerPoint
* Appendix A and B, printed on A3 paper (one per group of 3)
 |  |

## Learning episode 4 – expand your mind

### Teaching and learning activity

Students expand and simplify algebraic expressions by interacting with visual representations of expressions.

### Syllabus content

* Expand algebraic expressions, including those with negative coefficients
* Expand and simplify algebraic expressions by removing grouping symbols and collecting like terms where appropriate

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Expand your mind (DOCX 693 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l04-expand-your-mind.docx)Duration**:** 1–2 lessonsLearning intention* To be able to expand and simplify algebraic expressions using the distributive law.

Success criteria* I can use visual representations to show how to expand expressions.
* I can collect like terms to simplify an expression.
* I can expand expressions with negative coefficients.
* I can expand expressions with algebraic coefficients.
 | * [*Expand your mind* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l04-expand-your-mind.docx) PowerPoint
* Digital device per pair of students (optional)
* Appendix E, printed (one per pair)
* Appendix A and F, printed (one per student)
* Appendix B, C and D, printed in A3 (one per group of 3)
 |  |

## Learning episode 5 – factor it in

### Teaching and learning activity

Students factorise algebraic expressions, including those with indices by determining the highest common factor (HCF).

### Syllabus content

* Factorise algebraic expressions, including those involving indices, by determining the highest common factors (HCF) including negative coefficients/pronumerals

Table 5 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Factor it in (DOCX 386 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l05-factor-it-in.docx)Duration**:** 2 lessonsLearning intention* To be able to factorise algebraic expressions.

Success criteria* I can identify common factors in algebraic expressions.
* I can recognise the highest common factor of terms, including those that are negative.
* I can recognise the highest common factor of terms, including those with indices.
* I can factorise expressions involving negative terms.
* I can factorise expressions involving indices.
 | * [*Factor it in* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l05-factor-it-in-slideshow.pptx) PowerPoint
* Digital device per pair of students
* Appendices A and E, printed on A3 paper (one per group of 3)
* Appendices B, C and F, printed (one per student)
* Appendix D (teacher copy only)
 |  |

## Learning episode 6 – age-old question

### Teaching and learning activity

Students use real-life contexts to look at solving equations with fractions, including those with an unknown in the denominator.

### Syllabus content

* Solve linear equations involving one algebraic fraction using up to 3 steps

Table 6 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Age-old question (DOCX 765 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l06-age-old-question.docx)Duration**:** 2 lessonsLearning intentions* To be able to solve equations with a fraction as a constant.
* To be able to solve equations with a pronumeral in the denominator.

Success criteria* I can recognise the inverse operations needed to solve an equation.
* I can apply operations to move the pronumeral from the denominator to the numerator.
* I can apply the correct operations to solve an equation.
 | * [*Age-old question* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l06-age-old-question-slideshow.pptx) PowerPoint
* Appendices D and E, printed on A3 paper (one per group of 3)
* Appendices A, B, C and D, printed (one per student)
 |  |

## Learning episode 7 – packing then unpacking

### Teaching and learning activity

Students build their own equations working backward from the solutions. They explore a visual representation of equations and formalise working out for solving equations with 3 or more steps.

### Syllabus content

* Solve linear equations using algebraic techniques involving up to 3 steps
* Solve linear equations involving grouping symbols
* Verify solutions using substitution
* Solve linear equations involving one algebraic fraction using up to 3 steps
* Solve linear equations involving more than 3 steps (Path)

Table 7 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Packing then unpacking (DOCX 837 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l07-packing-then-unpacking.docx)Duration**:** 1–2 lessonsLearning intentions* To be able to construct equations from a solution.
* To understand the connection between building and solving equations.

Success criteria* I can construct equations with 3 or more steps.
* I can express an equation using a visual representation
* I can solve equations with 3 or more steps.
* I can check solutions through substitution.
 | * [*Packing then unpacking* (PPTX 2.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l07-packing-then-unpacking-slideshow.pptx) PowerPoint
* Appendix A, B and C, printed on A3 paper (one per group of 3)
* Appendix D and E, printed (one per student)
 |  |

## Learning episode 8 – Does it matter where you start?

### Teaching and learning activity

Students investigate different equations with pronumerals on both sides to conclude that there are multiple ways to solve the equation.

### Syllabus content

* Solve linear equations using algebraic techniques involving up to 3 steps
* Solve linear equations with pronumerals on both sides of the equation
* Verify solutions using substitution

Table 8 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required Resources | Registration, adjustments and evaluation notes |
| [Does it matter where you start? (DOCX 395 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l08-does-it-matter-where-you-start.docx)Duration**:** 1–2 lessonsLearning intention* To be able to solve linear equations with an unknown on either side of the equal sign.

Success criteria* I can add and subtract like terms.
* I can use inverse operations to solve equations.
* I can check my answer by using substitution.
* I can show multiple ways to solve an equation with pronumerals on both sides.
 | * [*Does it matter where you start?* (PPTX 2.1 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s5-unit-10-l08-does-it-matter-where-you-start-slideshow.pptx) PowerPoint
* At least one device between 2 people (optional)
* Appendix A, printed (one for teacher if using alternate launch)
* Appendix B (printed for teacher and table copied for each group if using alternate explore)
* Appendix C, printed, (2 per group of 3 to allow groups to complete 2 different equation sets)
 |  |

# References

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NESA (NSW Education Standards Authority) (n.d.) ‘[Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units)’, Programming, NESA website, accessed 20 June 2024.

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