# Mathematics Stage 4 – unit of learning – multiplicative thinking



Contents

[Rationale 3](#_Toc144910417)

[Overview 4](#_Toc144910418)

[Outcomes 5](#_Toc144910419)

[Core 5](#_Toc144910420)

[Related Life Skills outcomes 5](#_Toc144910421)

[Lesson sequence and details 7](#_Toc144910422)

[Learning episode 1 – negative groups of negatives 7](#_Toc144910423)

[Learning episode 2 – sharing, grouping and negating 9](#_Toc144910424)

[Learning episode 3 – area models and divisibility tests 11](#_Toc144910425)

[Learning episode 4 – the ants go marching 13](#_Toc144910426)

[Learning episode 5 – a big problem with small numbers 15](#_Toc144910427)

[Learning episode 6 – the magical factor trees 17](#_Toc144910428)

[Learning episode 7 – that’s about right 19](#_Toc144910429)

[Learning episode 8 – a quick guess 21](#_Toc144910430)

[Learning episode 9 – cooking for one 23](#_Toc144910431)

[Learning episode 10 – a shopping plan 25](#_Toc144910432)

[Learning episode 11 – when it’s fair to compare the pair 27](#_Toc144910433)

[Learning episode 12 – a fair share 29](#_Toc144910434)

[Learning episode 13 – the order of things 31](#_Toc144910435)

[Learning episode 14 – four fours 33](#_Toc144910436)

[Learning episode 15 – groups of mysteries 35](#_Toc144910437)

[Learning episode 16 – dividing into the unknown 37](#_Toc144910438)

[Learning episode 17 – which number goes here? (multiplying and dividing) 39](#_Toc144910439)

[Learning episode 18 – inverse journeys 41](#_Toc144910440)

[Learning episode 19 – make it clear 43](#_Toc144910441)

[References 45](#_Toc144910442)

## 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/school processes.

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](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming) 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 Computation with integers, Fractions, decimals and percentages, Algebraic techniques and Indices. The lessons and sequences in this program of learning are designed to allow students to explore the multiplication and division of integers, fractions, and algebraic terms. A variety of visual representations are developed as tools students can rely on within this unit and beyond.

**Duration:** this program of learning is designed to be completed over a period of approximately 6 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**
* **compares, orders and calculates with integers to solve problems MA4-INT-C-01**
* **represents and operates with fractions, decimals and percentages to solve problems MA4-FRC-C-01**
* **generalises number properties to operate with algebraic expressions including expansion and factorisation MA4-ALG-C-01**
* **operates with primes and roots, positive-integers and zero indices involving numerical bases and establishes the relevant index laws MA4-IND-C-01**

### Related Life Skills outcomes

The identified Life Skills outcomes that relate to this unit are **MALS-FRC-01** – demonstrates knowledge of fractions in everyday contexts, **MALS-DEP-01** – demonstrates knowledge of decimals and percentages in everyday contexts, **MALS-MDI-01** – uses strategies for multiplication and division, **MALS-PAT-01** – recognises and applies patterns in everyday contexts.

[Mathematics K–10 Syllabus](https://curriculum.nsw.edu.au/syllabuses/mathematics-k-10-2022) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

**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 – negative groups of negatives

#### Teaching and learning activity

Students develop and use a variety of representations, including counters and zero pairs, to model multiplication of positive and negative integers. They will play a game involving dice and cards to practise representing products.

#### Syllabus content

* Represent multiples of negative integers as repeated addition
* Multiply and divide positive and negative integers with and without the use of digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Negative groups of negatives](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-01-negative-groups-of-negatives.docx)Duration: 1–2 lessonsLearning intentions* To understand why multiplying a negative integer and a positive integer gives a negative result.
* To understand why multiplying 2 negative integers gives a positive result.

Success criteria* I can multiply positive and negative numbers.
* I can represent multiplication with negative using counters.
* I can give reasons for results when multiplying with negatives.
 | * [*Negative groups of negatives*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-01-negative-groups-of-negatives.pptx) PowerPoint
* 6-sided dice, one per group of students
* Decks of playing cards, one per group of students
* Device with internet access per pair of students (Optional)
* Two sets of Appendix A, printed, per group of students
* Class set of Appendix B, C and D, printed
 |  |

### Learning episode 2 – sharing, grouping and negating

#### Teaching and learning activity

Students examine division as equal sharing and forming sized groups to consider how each view of division has applications it is more suited to. Students then extend these 3 views to considering scenarios for dividing with negative numbers, using counters to represent operations.

#### Syllabus content

* Multiply and divide positive and negative integers with and without the use of digital tools

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Sharing, grouping and negating](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-02-sharing-grouping-and-negating.docx)Duration: 1–2 lessonsLearning intention* To understand why dividing a negative integer and a positive integer gives a negative result.
* To understand why dividing 2 negative integers gives a positive result.

Success criteria* I can divide with positive and negative numbers.
* I can represent division with negatives using counters.
* I can give reasons for results when dividing with negatives.
 | * [*Sharing, grouping and negating*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-02-sharing-grouping-and-negating.pptx) PowerPoint
* Class set of Appendix A, B, C and D, printed
* A large pile of counters or base-10 blocks per group of students
 |  |

### Learning episode 3 – area models and divisibility tests

#### Teaching and learning activity

Students use explore area models and use them to develop and explain divisibility tests.

#### Syllabus content

* Determine and apply tests for divisibility for 2, 3, 4, 5, 6 and 10

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Area models and divisibility tests](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-03-area-models-and-divisibility-tests.docx)Duration: 1–2 lessonsLearning intention* To be able to represent multiplications and divisions of integers using area models.
* To understand divisibility tests for 2, 3, 4, 5, 6 and 10.

Success criteria* I can use an area model to explain a large multiplication.
* I can construct an area model to represent a division.
* I can explain why a number is or is not divisible by another integer.
 | * [*Area models and divisibility tests*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-03-area-models-and-divisibility-tests.pptx) PowerPoint
* Two 6-sided dice per group of students
* Two different colours of highlighter pens per group of students
* One copy of Appendix A ‘Blockout game board’ per group, printed
* Base-10 blocks
* Class set of Appendix B, C, D, E and F, printed
* One device with internet access per pair of students (optional)
 |  |

### Learning episode 4 – the ants go marching

#### Teaching and learning activity

Students calculate numerical terms with squares, cubes and other positive integer powers whilst learning how to effectively communicate about these concepts.

#### Syllabus content

* Describe numbers written in index form using terms such as *base*, *power*, *index* and *exponent*
* Represent numbers in index notation limited to positive powers
* Represent in expanded form and evaluate numbers expressed in index notation, including powers of 10
* Represent a whole number greater than one as a product of its prime factors, using index notation where appropriate

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [The ants go marching](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-04-the-ants-go-marching.docx)Duration: 1 lessonLearning intention* To be able to calculate numerical terms with indices.
* To be able to communicate effectively using the mathematical language of indices.

Success criteria* I can multiply to find the square and cube of a number.
* I can multiply numbers written in index form.
* I can write and verbalise in index form.
 | * [*The ants go marching*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-04-the-ants-go-marching.pptx) PowerPoint
* Counters, approximately 25 per pair
* Centi-cubes, approximately 100 per pair
* Copy of Appendix A, per student
* Blank A4 paper or copies of Appendix D for each student
* Printed copy of Appendix E and F per pair
 |  |

### Learning episode 5 – a big problem with small numbers

#### Teaching and learning activity

Students explore the exponential growth that occurs with powers, particularly with powers of 10.

#### Syllabus content

* Represent numbers in index notation limited to positive powers
* Represent in expanded form and evaluate numbers expressed in index notation, including powers of 10

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [A big problem with small numbers](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-05-a-big-problem-with-small-numbers.docx)Duration: 1 lessonLearning intention* To be able to evaluate numbers expressed in index notation.
* To understand the growing effect of an exponent on the magnitude of a number.

Success criteria* I can repeatedly multiply a number by itself.
* I can represent multiples of 10 in index form.
* I can compare the value of numbers written in index form.
 | * [*A big problem with small numbers*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-05-a-big-problem-with-small-numbers.pptx) PowerPoint
* Copy of Appendix A per student
* Copy of Appendix B per group of students
 |  |

### Learning episode 6 – the magical factor trees

#### Teaching and learning activity

Students will examine square roots and cube roots, linking their knowledge of squares and cubes. They will use factor trees to write a number as a product of its prime factors in index notation.

#### Syllabus content

* Represent a whole number greater than one as a product of its prime factors, using index notation where appropriate
* Use the notations for square root and cube root
* Recognise and describe the relationship between squares and square roots, and cubes and cube roots for positive numbers
* Verify, through numerical examples, that $\sqrt{ab}=\sqrt{a}×\sqrt{b}$

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [The magical factor trees](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-06-the-magical-factor-trees.docx)Duration: 1–2 lessonsLearning intention* To be able to apply index notation to represent whole numbers as products of powers of prime numbers.
* To be able to calculate cube roots and square roots.

Success criteria* I can represent a whole number greater than one as a product of its prime factors using index notation.
* I can use the notations for square root and cube root.
* I can recognise and describe the relationship between squares and square roots for positive numbers.
* I can show that $\sqrt{ab}=\sqrt{a}×\sqrt{b}$ using numerical examples.
 | * [*The magical factor trees*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-06-the-magical-factor-trees.pptx) PowerPoint
* Class set of Appendix A and B, printed
* One set of Appendix C, a set for each group of 3, printed
 |  |

### Learning episode 7 – that’s about right

#### Teaching and learning activity

Students will estimate the value of square roots and cube roots.

#### Syllabus content

* Use the notations for square root and cube root
* Recognise and describe the relationship between squares and square roots, and cubes and cube roots for positive numbers
* Estimate the square root of any non-square whole number and the cube root of any non-cube whole number, then check using a calculator
* Identify and describe exact and approximate solutions in the context of square roots and cube roots

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [That’s about right](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-07-thats-about-right.docx)Duration: 1–2 lessonsLearning intention* To be able to calculate cube roots and square roots.

Success criteria* I can estimate the square root of any non-square whole number.
* I can identify and describe approximate solutions in the context of square roots.
 | * [*That’s about right*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-07-thats-about-right.pptx) PowerPoint
* One set of Appendix A, printed and cut into individual targets
* Class set of Appendix B, printed
* One set of Appendix C and Appendix D, for each group of 3, printed
 |  |

### Learning episode 8 – a quick guess

#### Teaching and learning activity

Students make fast estimates comparing which will be larger when multiplying and sharing quantities of items. They examine the impact of multiplying and dividing by numbers greater than and less than one and develop and articulate methods for estimating when multiplying with fractions.

#### Syllabus content

* Compare and generalise the effect of multiplying or dividing by a number with magnitude between zero and one
* Compare initial estimates with the results of calculations
* Apply knowledge of fractions and decimals of quantities to solve problems
* Apply knowledge of multiplication and division of fractions and decimals to solve problems

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [A quick guess](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-08-a-quick-guess.docx)Duration: 1 lessonLearning intention* To understand why multiplying quantities by numbers greater than one makes the quantity grow larger.
* To understand why multiplying quantities by numbers less than one makes the quantity become smaller.
* To be able to estimate fractions of quantities.

Success criteria* I can explain the effect of multiplying quantities by numbers either side of one.
* I can apply strategies to estimate calculations with fractions and decimals.
 | * [*A quick guess*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-08-a-quick-guess.pptx) PowerPoint
* Class set of Appendix A and B, printed
* Device with internet or a calculator, one per group
* Decks of cards, one per group, picture cards removed
 |  |

### Learning episode 9 – cooking for one

#### Teaching and learning activity

Students alter recipes, multiplying quantities by common fractions. They explore area models to represent fraction and decimal multiplication.

#### Syllabus content

* Represent multiplication and division of decimals
* Represent multiplication and division of fractions, including mixed numbers
* Multiply and divide decimals, using digital tools to solve problems
* Multiply and divide fractions and mixed numbers, with and without using digital tools to solve problems
* Apply knowledge of fractions and decimals of quantities to solve problems
* Apply knowledge of multiplication and division of fractions and decimals to solve problems

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Cooking for one](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-09-cooking-for-one.docx)Duration: 1 lessonLearning intention* To be able to represent multiplication between fractions and decimals using area models.
* To be able to perform multiplication with fractions and decimals.

Success criteria* I can divide rectangles into equal parts to represent fractions and decimals.
* I can create area models to represent fraction and decimal multiplication.
* I can explain why multiplication between fractions can be performed by multiplying numerators and multiplying denominators.
 | * [*Cooking for one*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-09-cooking-for-one.pptx) PowerPoint
* One A4 sheet of paper per student
* Class set of Appendix A, B, C, D and E, printed
* One device with internet access per pair of students (optional)
 |  |

### Learning episode 10 – a shopping plan

#### Teaching and learning activity

Students solve problems involving division of fractions. They compare fractions of foods they use daily with the quantity remaining. This leads into formally representing division of fractions.

#### Syllabus content

* Represent multiplication and division of decimals
* Represent multiplication and division of fractions, including mixed numbers
* Multiply and divide decimals, using digital tools to solve problems
* Multiply and divide fractions and mixed numbers, with and without using digital tools to solve problems
* Apply knowledge of fractions and decimals of quantities to solve problems
* Apply knowledge of multiplication and division of fractions and decimals to solve problems

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [A shopping plan](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-10-a-shopping-plan.docx)Duration: 1 lessonLearning intention* To understand the division of fractions as forming sized groups.
* To be able to represent division of fractions and determine solutions from the representation.

Success criteria* I can represent the division of fractions by comparing area models.
* I can explain the division of fractions as forming groups of a certain size.
 | * [*A shopping plan*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-10-a-shopping-plan.pptx)PowerPoint
* Class set of Appendix A, B and C, printed
 |  |

### Learning episode 11 – when it’s fair to compare the pair

#### Teaching and learning activity

Students use statistics to compare the performance of elite Australian professional footballers. They establish a need for and learn to calculate quantities as percentages of other quantities, including goals scored as a percentage of shots taken.

#### Syllabus content

* Represent one quantity as a fraction, decimal or percentage of another by considering appropriate units

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [When it’s fair to compare the pair](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-11-when-its-fair-to-compare-the-pair.docx)Duration: 1 lessonLearning intention* To understand the need to use fractions, decimals and percentages to compare quantities.
* To be able to find one quantity as a percentage of another.

Success criteria* I can explain why a given statistic needs to be compared with another.
* I can use a calculator to find one quantity as a percentage of another.
* I can use equivalent fractions or percentages to compare statistics fairly.
 | * [*When it’s fair to compare the pair*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-11-when-its-fair-to-compare-the-pair.pptx) PowerPoint
* Class set of scientific calculators
* One device with internet access, per pair of students (optional)
 |  |

### Learning episode 12 – a fair share

#### Teaching and learning activity

Students review situations where common totals are added or subtracted from different significantly different quantities before applying common percentages to make increases and decreases ‘fair’.

#### Syllabus content

* Calculate percentage increases and decreases in various contexts
* Examine the financial applications of percentage increase and decrease, including profit and/or loss as a percentage of cost price or selling price

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [A fair share](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-12-a-fair-share.docx)Duration: 1 lessonLearning intention* To understand that percentage increases and decreases depend on the original quantity.
* To be able to visually represent, calculate and interpret percentage increases and decreases.

Success criteria* I can calculate a percentage of a quantity.
* I can represent percentage increases and decreases using a bar model.
* I can compare percentage increases and decreases of different quantities.
* I can explain why percentage increases and decreases are often applied for ‘fairness’.
 | * [*A fair share*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-12-a-fair-share.pptx) PowerPoint
* Class set of Appendix A, B, C and D, printed
* A device with internet access, per group of students
 |  |

### Learning episode 13 – the order of things

#### Teaching and learning activity

Students consider the implications of not using the order of operations and establish the need for rules before applying them. This lesson does not introduce the use of brackets in expressions, instead focusing on the conventions to evaluate powers, multiplication, division, addition and subtraction within a single expression.

#### Syllabus content

* Apply the 4 operations to integers
* Apply the order of operations to evaluate expressions involving integers, with and without the use of digital tools
* Apply the order of operations to evaluate expressions involving indices

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [The order of things](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-13-the-order-of-things.docx)Duration: 1–2 lessonsLearning intention* To understand the need for rules around the order of operations.
* To know the rules established to evaluate expressions.

Success criteria* I can apply the order of operations to evaluate expressions.
* I can explain how expressions can give multiple results if we don’t apply the order of operations correctly.
 | * [*The order of things*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-13-the-order-of-things.pptx) PowerPoint
* Class set of Appendix A, B and C, printed
 |  |

### Learning episode 14 – four 4’s

#### Teaching and learning activity

Students analyse expressions using the four operations and exactly four ‘4’s to identify errors. Students then use brackets to modify expressions to change the order of operations.

This lesson assumes that students have experience with foundational order of operation concepts.

#### Syllabus content

* Apply the 4 operations to integers
* Solve problems involving grouping symbols with integers
* Apply the order of operations to evaluate expressions involving integers, with and without the use of digital tools
* Apply the order of operations to evaluate expressions involving indices
* Apply the order of operations to evaluate expressions involving square roots, cube roots, square numbers and cube numbers

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Four fours](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-14-four-fours.docx)Duration: 1–2 lessonsLearning intention* To understand how brackets impact the order of operations when evaluating an expression.

Success criteria* I can explain the order that calculations need to be performed in an expression.
* I can add brackets to an expression to change the value.
 | * [*Four fours*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-14-four-fours.pptx) PowerPoint
* Appendix A and B printed, one per group
* Class set of Appendix C, printed
 |  |

### Learning episode 15 – groups of mysteries

#### Teaching and learning activity

Students use area models to explore conventions of simplifying algebraic expressions involving multiplication.

#### Syllabus content

* Generalise the associative property of addition and multiplication to algebraic expressions
* Generalise the commutative property to algebraic expressions
* Simplify algebraic expressions that involve multiplication and division, including simple algebraic fractions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Groups of mysteries](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-15-groups-of-mysteries.docx)Duration: 1–2 lessonsLearning intention* To understand common conventions for writing and simplifying algebraic expressions involving multiplication.

Success criteria* I can interpret algebraic terms involving multiplication.
* I can simplify algebraic expressions involving multiplication.
* I can construct an area model to represent the multiplication of 2 algebraic terms.
 | * [*Groups of mysteries*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-15-groups-of-mysteries.pptx) PowerPoint
* Class set of Appendix A, B, E and F, printed
* Device with internet access (optional)
 |  |

### Learning episode 16 – dividing into the unknown

#### Teaching and learning activity

Students use area models to explore conventions of simplifying algebraic expressions involving division. They use dynamic and pictorial models before moving to abstract representations of division.

This lesson is based on students having had experience with using area models to represent numerical division.

#### Syllabus content

* Simplify algebraic expressions that involve multiplication and division, including simple algebraic fractions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Dividing into the unknown](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-16-dividing-into-the-unknown.docx)Duration: 1 lessonLearning intention* To understand common conventions when writing and simplifying algebraic expressions involving division.
* To be able to use an area model to explain how algebraic expressions with division simplify.

Success criteria* I can interpret algebraic terms involving division.
* I can simplify algebraic expressions involving division.
* I can construct an area model to represent division between 2 algebraic terms.
 | * [*Dividing into the unknown*](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-16-dividing-into-the-unknown.pptx) PowerPoint
* Class set of Appendix A, B and E, printed
* Device with internet access (optional)
 |  |

### Learning episode 17 – which number goes here? (multiplying and dividing)

#### Teaching and learning activity

Students investigate alternative representations for numbers, leading to algebraic expressions.

#### Syllabus content

* Simplify algebraic expressions that involve multiplication and division, including simple algebraic fractions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Which number goes here?](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-17-which-number-goes-here-multiplying-dividing.docx)Duration: 1 lessonLearning intention* To be able to write and simplify algebraic expressions.
* To understand algebraic conventions and ways of writing expressions.

Success criteria* I can write an expression for a number or term that appears in the row before or after a number in the grid.
* I can substitute a number into an algebraic expression.
 | * Class set of Appendix A and B, printed
* Grid algebra file: ‘[1 to 30 grid (no negatives)](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-17-1-to-30-grid-no-negatives.json)’
* Grid algebra file: ‘[Multiplying and dividing with letters](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-17-multiplying-and-dividing-with-letters.json)’
* Device with internet access per pair (optional)
 |  |

### Learning episode 18 – inverse journeys

#### Teaching and learning activity

Students use Grid Algebra to explore the multiplication and division of algebraic terms.

#### Syllabus content

* Simplify algebraic expressions that involve multiplication and division, including simple algebraic fractions

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Inverse journeys](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-18-inverse-journeys-multiplying.docx)Duration: 1 lessonLearning intention* To identify that multiplication is the inverse of division and vice versa.

Success criteria* I can identify the inverse of a given number.
* I can use inverses to calculate a variable’s original value.
 | * Class set of Appendix A and B, printed
* Grid algebra file: ‘[Inverse Journeys – Multiplying](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-18-inverse-journeys-multiplying.json)’
* Device with internet access per pair (optional)
 |  |

### Learning episode 19 – make it clear

#### Teaching and learning activity

Students use the order of operations to evaluate numerical expressions and examine the same expressions with algebraic terms introduced to consider how these rules apply generally.

This lesson is designed based on students having successful previous experience with applying the order of operations to evaluate numerical expressions.

#### Syllabus content

* Simplify algebraic expressions that involve multiplication and division, including simple algebraic fractions
* Simplify algebraic expressions involving mixed operations

Table – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Make it clear](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-05-lesson-19-make-it-clear.docx)Duration: 1 lessonLearning intention* To understand how order of operations rules apply to algebraic expressions.

Success criteria* I can compare numerical and algebraic expressions.
* I can use the order of operations to simplify algebraic expressions.
* I can explain the difference between similar algebraic expressions, such as $4÷2×x$ and $4÷2x$.
 | * One copy of Appendix A, B, C and D per group of 4, printed
* Class set of Appendix E, F and G, printed
 |  |

## References

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