# Mathematics Stage 4 – unit of learning – representing numbers



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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/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 and Linear relationships. The lessons and sequences in this program of learning are designed to allow students to explore quantity of numbers and the different ways of representing this quantity. They consider the equivalence between different representations of numbers and the structural elements of numbers that form quantity.

**Duration:** this program of learning is designed to be completed over a period of approximately 5 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

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**
* creates and displays number patterns and finds graphical solutions to problems involving linear relationships **MA4-LIN-C-01**

The identified Life Skills outcomes that relate to this unit are **MALS-REP-01** – represents number in everyday contexts, **MALS-COM-01** – compares and orders numbers, **MALS-FRC-01** – demonstrates knowledge of fractions in everyday contexts, **MALS-DEP-01** – demonstrates knowledge of decimals and percentages in everyday contexts, and **MALS-PAT-01** – recognises and applies patterns in everyday contexts.

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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 – highest common factor of integers

#### Teaching and learning activity

Students solve problems of equally sharing different quantities to explore the concept of a highest common factor, using factor trees and Venn diagrams.

#### Syllabus content

* Determine the highest common factor (HCF) of 2 whole numbers

Table 1 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Highest common factor of integers](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-01-highest-common-factor-of-integers.docx)Duration: 1 lessonLearning intention* To be able to establish the highest common factor between integer values.

Success criteria* I can use a prime factor tree to redefine a number.
* I can use prime factor trees to find all the common prime factors between 2 integers.
* I can multiply the common prime factors to find the highest common factor between 2 integers.
* I can use a Venn diagram to represent the highest common factor between 2 integers.
 | * Class set of Appendix A, printed
* Class set of 2 different coloured counters
* Class set of large grid paper
 |  |

### Learning episode 2 – less than zero

#### Teaching and learning activity

Students develop a need to use negative numbers through losing points in games. Students then use paper folding to construct a number line involving negative numbers and examine and use the reflective property of negative numbers.

#### Syllabus content

* Identify and represent integers on a number line

Table 2 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Less than zero](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-02-less-than-zero.docx)Duration: 1 lessonLearning intention* To understand negative numbers as a reflection of positive numbers.

Success criteria* I can place negative numbers on a number line.
* I can order numbers below zero.
* I can explain how negative numbers reflect the positive numbers on a number line.
 | * Class set of 6-sided dice.
* Class set of coins or 2-coloured counters
* Mini whiteboards or A4 piece of paper per student
* Class set of long, thin strips of paper, cut from A4 or A3 paper or from paper stripping
* Paper clips, 2 per student
* Class set of Appendix A and B, printed
* Device per pair of students (optional)
 |  |

### Learning episode 3 – direction and magnitude

#### Teaching and learning activity

Students use distance and position as contexts to consider both the direction and magnitude of integers, investigating phrases that indicate direction.

#### Syllabus content

* Recognise and describe the direction and magnitude of integers
* Compare the relative value of integers using the less than (<) and greater than (>) symbol
* Order integers

Table 3 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Direction and magnitude](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-03-direction-and-magnitude.docx)Duration: 1 lessonLearning intentions* To be able to describe the direction and the magnitude of integers.
* To compare the size of integers based on their position on the number line.

Success criteria* I can place integers on a number line.
* I can state the direction and magnitude of an integer presented in many forms.
* I can explain why magnitudes are always positive.
* I can compare the size of integers by placing them on a number line.
 | * Device with internet access per pair of studentsOR

Cones or markers, 3 per group of students* Class sets of Appendix A, B and D
* Device to take photos (optional)
* Appendix C (optional)
 |  |

### Learning episode 4 – zero pairs

#### Teaching and learning activity

Students use balloons and weights in a Desmos activity to investigate going up and down and the idea of zero pairs cancelling out to represent integers in infinite ways.

#### Syllabus content

* Recognise and describe the direction and magnitude of integers

Table 4 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Zero pairs](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-04-zero-pairs.docx)Duration: 1–2 lessonsLearning intention* To be able to use zero pairs to represent integers in infinite ways.

Success criteria* I can use zero pairs to represent integers.
* I can explain why there are infinite ways to make any given whole number.
 | * Set of Appendix A printed, cut into cards, one set per group of students
* Class set of Appendix B, printed
* Device per pair of students (optional)
 |  |

### Learning episode 5 – listen to the music

#### Teaching and learning activity

In this activity, students explore the way fractions can be used to describe and compare music. They then generate equivalent fractions and examine their impact on related aspects of a song.

#### Syllabus content

* Examine methods of generating equivalent fractions
* Compare and order fractions with different denominators
* Create fractions with the same denominator to compare their sizes

Table 5 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Listen to the music](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-05-listen-to-the-music.docx)Duration: 1–2 lessonsLearning intention* To be able to generate equivalent fractions, utilising auditory, symbolic and visual representations.

Success criteria* I can use a bar model to represent fractions.
* I can use a bar model to generate equivalent fractions.
 | * Device with internet access for individual students or per pair of students
 |  |

### Learning episode 6 – recipe for success

#### Teaching and learning activity

Students explore different combinations of fractional measuring cups to obtain specific quantities for a recipe, deepening their understanding of equivalent fractions.

#### Syllabus content

* Examine methods of generating equivalent fractions
* Simplify fractions by using methods, including determining the HCF of the numerator and denominator or repeated simplification using common factors
* Compare and order fractions with different denominators
* Create fractions with the same denominator to compare their sizes

Table 6 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Recipe for success](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-06-recipe-for-success.docx)Duration: 1–2 lessonsLearning intention* To be able to generate equivalent fractions.

Success criteria* I can compare fractions with different denominators.
* I can find equivalent fractions using number lines.
* I can generate equivalent fractions to solve problems.
 | * Sets of measuring cups
* Class set of Appendix A, B, C and D, printed
* To complete the Apply section, recipe ingredients
* [*Recipe for success*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-06-recipe-for-success.pptx)PowerPoint
* Device per pair of students (optional)
 |  |

### Learning episode 7 – inventing units of measurement

#### Teaching and learning activity

Students create a unique unit of measurement with a strip of paper and use it to measure lengths of common objects. Students fold their strip of paper to create fractions to aid more accurate measurement, develop relationships between equivalent fractions and begin representing these fractions as decimals.

#### Syllabus content

* Examine methods of generating equivalent fractions
* Create fractions with the same denominator to compare their sizes
* Compare and order fractions with different denominators
* Represent fractions as decimals (terminating and recurring) and percentages
* Represent improper fractions as mixed numbers and decimals, and vice versa

Table 7 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Inventing units of measurement](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-07-inventing-units-of-measurement.docx)Duration: 2 lessonsLearning intentions* To understand the usefulness of fractions in describing what is between whole number units.
* To be able to convert common fractions into decimals.

Success criteria* I can use fractions to describe lengths that are not exact, whole units.
* I can compare the size of fractions.
* I can convert fractions to decimals.
 | * Class set of long strips of paper of varying lengths
* [*Inventing units of measurement*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-07-inventing-units-of-measurement.pptx)PowerPoint
* Class set of Appendix A
* Device per pair of students (optional)
 |  |

### Learning episode 8 – the nasty game

#### Teaching and learning activity

Students create fractions by rolling 10-sided dice and establish a range of visual representations to compare the size of their results.

#### Syllabus content

* Compare and order fractions with different denominators

Table 8 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [The nasty game](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-08-the-nasty-game.docx)Duration: 2 lessonsLearning intention* To be able to use visual representations to show and compare the size of fractions.

Success criteria* I can compare fractions.
* I can represent fractions visually in a variety of ways.
 | * 10-sided dice, one per group of students (or virtual dice)
* 2-sided counters or 2 colours of connector blocks, one large pile per group
* Class sets of Appendix A, B, C, E , G and H, printed
* Device per pair of students (optional)
 |  |

### Learning episode 9 – comparing using place value

#### Teaching and learning activity

Students use concrete and online manipulatives, as well as visual representations, to compare common measurements in decimal form, placing them on a number line.

#### Syllabus content

* Locate positive and negative fractions, decimals and mixed numbers on a number line to compare their relative values
* Compare and order fractions, mixed numbers, decimals (terminating and recurring) and percentages

Table 9 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Comparing using place value](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-09-comparing-using-place-value.docx)Duration: 1 lessonLearning intentions* To understand the relationship between place values of a decimal number.
* To be able to place decimals on a number line.

Success criteria* I can compare decimals using place value.
* I can represent a decimal to thousandths.
* I can place decimals on a number line to compare their size.
 | * Class set of Appendix A, B, C, E, F, H and I, printed
* Sets of base 10 blocks or Polypad virtual manipulatives (optional)
* Device with internet access per pair of students (optional)
* [*Comparing using place value*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-09-comparing-using-place-value.pptx)PowerPoint
 |  |

### Learning episode 10 – approximate measurements

#### Teaching and learning activity

Students take measurements of length, weight and time and review differences between measurements from one student to another to consider the appropriate accuracy to record. Students learn to round decimals in the process.

#### Syllabus content

* Round decimals to a given number of decimal places
* Apply the notation ≈ as a symbol of numerical approximation
* Reason why an approximation may be more appropriate than an exact answer and vice versa

Table 10 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Approximate measurements](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-10-approximate-measurements.docx)Duration: 1 lessonLearning intentions* To understand why a measurement may be recorded with less decimal places than what it was measured in.
* To be able to round a measurement to a given number of decimal places.

Success criteria* I can explain why a measurement rounds in a particular way using a representation.
* I can round a measurement.
* I can explain why a measurement should be rounded.
 | * Tape measures
* Bathroom or kitchen scales
* Stopwatch or timer
* Class sets of Appendix A, B, D, E and F, printed
* Copies of Appendix C, printed
* Base 10 blocks or Polypad virtual manipulatives
* [*Approximate measurements*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-10-approximate-measurements.pptx) PowerPoint
 |  |

### Learning episode 11 – be rational

#### Teaching and learning activity

Students learn to convert integers, percentages and terminating decimals into fractions to identify all numbers we know as rational. Students then explore the concept of recurring (repeating) decimals and consider where an irrational number might arise.

#### Syllabus content

* Use either dot or vinculum notation for recurring (repeating) decimals
* Classify decimals as recurring or terminating
* Define rational numbers as numbers that can be written in the form $\frac{a}{b}$, where $a$ and $b$ are integers and $b\ne 0$
* Classify fractions and percentages as rational numbers
* Recognise and explain that numbers with terminating or recurring decimals are rational
* Represent terminating decimals as fractions and percentages

Table 11 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Be rational](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-11-be-rational.docx)Duration: 1 lessonLearning intentions* To be able to convert integers, percentages and terminating decimals into fractions.
* To understand why all numbers that we have studied so far are rational.

Success criteria* I can explain what a rational number is.
* I can give examples of terminating and recurring decimals.
* I can convert integers and percentages into fractions.
* I can convert terminating decimals into fractions.
 | * Class set of calculators
* Class set of Appendix A, B, C, D and E, printed
* Base 10 blocks or Polypad virtual manipulatives (optional)
* [*Be rational*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-11-be-rational.pptx) PowerPoint
 |  |

### Learning episode 12 – fractions and decimals and percentages, oh my!

#### Teaching and learning activity

Students identify and make use of the relationship between fractions, decimals and percentages to carry out conversions.

#### Syllabus content

* Represent fractions as decimals (terminating and recurring) and percentages
* Represent terminating decimals as fractions and percentages
* Represent percentages as fractions and decimals
* Represent improper fractions as mixed numbers and decimals, and vice versa

Table 12 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Fractions and decimals and percentages, oh my!](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-12-fractions-decimals-percentages.docx)Duration: 1–2 lessonsLearning intention* To be able to convert between fractions, decimals and percentages.

Success criteria* I can convert decimals into equivalent fractions and percentages.
* I can convert fractions into equivalent decimals and percentages.
* I can convert percentages into equivalent decimals and fractions.
* I can represent equivalent fractions, decimals, and percentages on a number line.
 | * Sticky tape or adhesive putty
* Class set of Appendix A, printed
* Single copy of Appendix B and C, cut into cards
* [*Fractions and decimals and percentages, oh my!*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-12-fractions-decimals-percentages.pptx) PowerPoint
* Device per pair of students (optional)
 |  |

### Learning episode 13 – describing locations

#### Teaching and learning activity

In this activity, students investigate the use of coordinates in the number plane to describe the location of points on maps and the importance of the location of an origin as a frame of reference.

#### Syllabus content

* Plot and label points on the Cartesian plane of given coordinates, including those with coordinates that are not whole numbers
* Identify and record the coordinates of given points on the Cartesian plane, including those with coordinates that are not whole numbers

Table 13 – lesson details

|  |  |  |
| --- | --- | --- |
| Visible learning | Required resources | Registration, adjustments and evaluation notes |
| [Describing locations](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-13-describing-locations.docx)Duration: 1 lessonLearning intentions* To understand the use of the Cartesian plane in describing locations.
* To be able to describe locations in a Cartesian plane using coordinates.

Success criteria* I can locate a coordinate in the Cartesian plane.
* I can describe a given location in a Cartesian plane using coordinates.
* I can explain how placing a Cartesian plane over a map can assist us to describe locations.
 | * Class set of Appendix A, C, E and F, printed
* Device with internet access per pair of students, or printed class set of Appendix D
* [*Describing locations*](https://edit.education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/mathematics/mathematics-s4-unit-03-lesson-13-describing-locations.pptx) PowerPoint
 |  |

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NESA (NSW Education Standards Authority) (2022) ‘[Programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming)’, Understanding the curriculum, NESA website, accessed 31 May 2023.

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