

Guidance for curriculum leaders and teachers

Numeracy: Improving thinking about fractions in Years 2–6

Purpose

The resources in this series support classroom practices for teaching fractions when implementing the:

- Australian Curriculum Version 9.0: Mathematics
- Interpreting fractions sub-element within the Number sense and algebra element of the Numeracy general capability.

The Interpreting fractions sub-element:

emphasises the development of fraction sense, which is foundational to learning how to reason proportionally. Students become increasingly able to recognise the part-whole description of a fraction, but also recognise and use fractions as numbers, measures, operators, ratios and as a division (ACARA, 2010 to present).

Learning goal

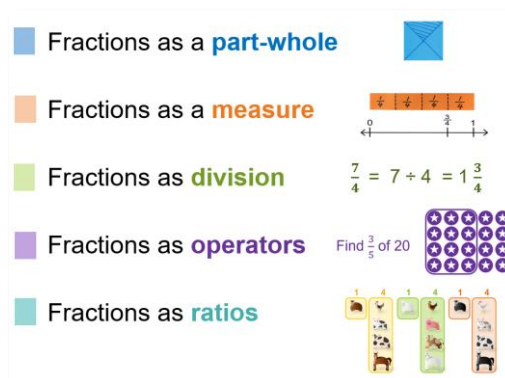
These resources support teachers to develop a deep understanding of how students' thinking about fractions develops through Years 2–6, recognising academic research that shows students find it challenging to:

- comprehend additional numbers between 0 and 1 (fractions)
- extend understanding beyond 1 to improper fractions and mixed numerals.

Teachers will understand how these challenges can be addressed through carefully sequenced teaching and learning activities. They will gain access to practical teaching strategies that develop students' conceptual understanding of and ability to interpret fractions, which will support students in other sub-elements and elements.

The resources feature five fraction constructs:

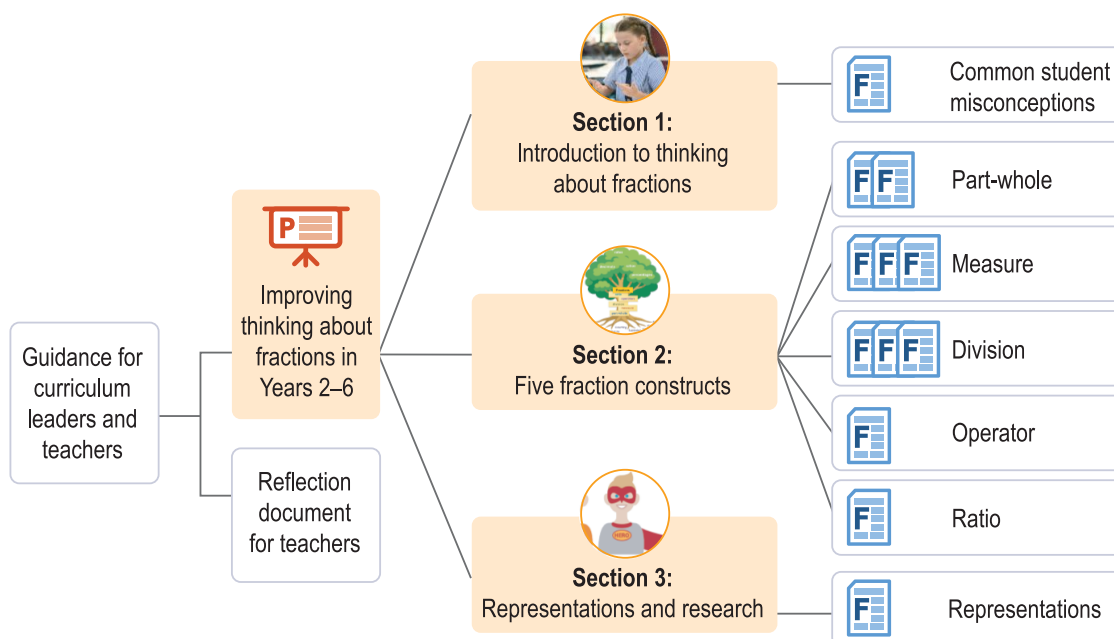
- part-whole
- measure
- division
- operators
- ratios.



How to use

The presentation slideshow is supported by:

- a reflection document for teachers to use, if the presentation is delivered formally
- a summary of common student misconceptions about fractions
- 11 strategy factsheets.



These resources can be used in professional development across year levels, departments and/or faculty groups.

Presentation

The presentation slideshow is intended for curriculum leaders to use as the basis for presentations to staff. However, teachers can also use the presentation for individual study.

The presentation can be delivered as a full-day workshop or as individual sections to suit school time and staff availability. Section 1 has 26 slides; Section 2 has 44 slides, containing 10 fraction construct activities; and Section 3 has 17 slides, containing one activity about representing fractions. These activities are supported by the strategy factsheets.

Section 2, the longest section, can be tailored to the time available by reducing the number of strategy factsheets that are considered.

Factsheets

Each strategy factsheet includes an overview, a step-by-step guide to using the strategy and additional ready-to-use templates (see [Appendix 4: Strategy factsheet — annotated sample](#)).

The strategy factsheets can be used in professional development and/or to support the design of lessons about aspects of thinking about fractions.

Strategies for fraction constructs

Ten strategies support student understanding of the five fraction constructs:

Part-whole	Measure	Division	Operators	Ratios
• Comparing quarters • What is the whole?	• What fraction time? • Walk the line • Money, money, money	• Multiplication squares • Dividing pancakes • Sharing snakes	• Fraction wall	• Creating and naming ratios

An additional strategy 'All the ways we represent a fraction' supports students' understanding of fraction representations.

Further strategies to support teaching of the constructs will become available — check the Numeracy page on the QCAA website: www.qcaa.qld.edu.au/p-10/aciq/version-9/general-capabilities/numeracy.

Using the strategies

In classrooms
Teachers can integrate these strategies into the classroom, selecting relevant strategies to meet the needs of students in their contexts — including phases of learning. • Appendix 1: Fractions in the Australian Curriculum summarises where fractions appear in the aspects of the achievement standard and related content descriptions of the Australian Curriculum v9.0: Mathematics. • Appendix 2: General capability — Numeracy learning progression summarises indicators from the <i>Interpreting fractions</i> sub-element of the Numeracy general capability.
Across learning areas
The development of thinking about fractions is primarily the responsibility of teachers of Mathematics. However, students will also encounter fractions in other learning areas and subjects, e.g. mixing chemicals in Science or reading the scale on a map in Geography. Most of the strategies can be adapted for use across several learning areas.
Across phases of learning
Most strategies can provide opportunities to develop numeracy skills at different levels of progression, e.g. while students in early years can use number lines to recognise common fractions, students in later years can also use number lines to learn about equivalent fractions and improper fractions.

References

Way, J. (n.d.). *Fractions*, Top drawer teachers: Resources for teachers of mathematics, Australian Association of Mathematics Teachers, <https://topdrawer.aamt.edu.au/Fractions>.

More information

If you would like more information, please visit the Numeracy page on the QCAA website: www.qcaa.qld.edu.au/p-10/aciq/version-9/general-capabilities/numeracy. Alternatively, phone (07) 3120 6102 or email the K–10 Curriculum and Assessment branch at australiancurriculum@qcaa.qld.edu.au.



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2. The ACARA National Numeracy Learning Progressions are licensed under a creative commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) licence.

Appendix 1: Fractions in the Australian Curriculum

Achievement standard aspects and related content descriptions

Year	Achievement standard	Related content descriptions
2	identify and represent part-whole relationships of halves, quarters and eighths in measurement contexts	- recognise and describe one-half as one of 2 equal parts of a whole and connect halves, quarters and eighths through repeated halving (AC9M2N03) - identify common uses and represent halves, quarters and eighths in relation to shapes, objects and events (AC9M2M02) - recognise and read the time represented on an analog clock to the hour, half-hour and quarter-hour (AC9M2M04) - identify, describe and demonstrate quarter, half, three-quarter and full measures of turn in everyday situations (AC9M2M05)
	determine the number of days between events using a calendar and read time on an analogue clock to the hour, half hour and quarter hour	- identify the date and determine the number of days between events using calendars (AC9M2M03) - recognise and read the time represented on an analog clock to the hour, half-hour and quarter-hour (AC9M2M04)
3	represent unit fractions and their multiples in different ways	recognise and represent unit fractions including $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ and $\frac{1}{10}$, and their multiples in different ways; combine fractions with the same denominator to complete the whole (AC9M3N02)
4	recognise equivalent fractions and make connections between fraction and decimal notations	- recognise and extend the application of place value to tenths and hundredths and use the conventions of decimal notation to name and represent decimals (AC9M4N01) - find equivalent representations of fractions using related denominators and make connections between fractions and decimal notation (AC9M4N03)
	count and represent fractions on a number line	count by fractions including mixed numerals; locate and represent these fractions as numbers on number lines (AC9M4N04)
5	order and represent, add and subtract fractions with the same or related denominators	- compare and order fractions with the same and related denominators including mixed numerals, applying knowledge of factors and multiples; represent these fractions on a number line (AC9M5N03) - solve problems involving addition and subtraction of fractions with the same or related denominators, using different strategies (AC9M5N05)

Year	Achievement standard	Related content descriptions
	represent common percentages and connect them to their fraction and decimal equivalents	recognise that 100% represents the complete whole and use percentages to describe, represent and compare relative size; connect familiar percentages to their decimal and fraction equivalents (AC9M5N04)
6	order common fractions, giving reasons, and add and subtract fractions with related denominators	- apply knowledge of equivalence to compare, order and represent common fractions including halves, thirds and quarters on the same number line and justify their order (AC9M6N03) - solve problems involving addition and subtraction of fractions using knowledge of equivalent fractions (AC9M6N05)
	solve problems involving finding a fraction, decimal or percentage of a quantity and use estimation to find approximate solutions to problems involving rational numbers and percentages	- apply knowledge of place value to add and subtract decimals, using digital tools where appropriate; use estimation and rounding to check the reasonableness of answers (AC9M6N04) - multiply and divide decimals by multiples of powers of 10 without a calculator, applying knowledge of place value and proficiency with multiplication facts; using estimation and rounding to check the reasonableness of answers (AC9M6N06) - solve problems that require finding a familiar fraction, decimal or percentage of a quantity, including percentage discounts, choosing efficient calculation strategies and using digital tools where appropriate (AC9M6N07) - approximate numerical solutions to problems involving rational numbers and percentages, including financial contexts, using appropriate estimation strategies (AC9M6N08)

Appendix 2: General capability — Numeracy learning progression

Element: Number sense and algebra

Sub-element: Interpreting fractions		Year
Progression level 1	Creating halves - demonstrates that dividing a whole into 2 parts can create equal or unequal parts - identifies the part and the whole in representations of one-half (e.g. joins 2 equal pieces back together to form the whole shape and can identify the pieces as equal parts of the whole shape) - creates equal halves of collections and physical and virtual materials using all of the whole (e.g. folds a paper strip in half to make equal pieces by aligning the edges; cuts a sandwich in half diagonally; partitions a collection into 2 equal groups to represent halving)	
Progression level 2	Repeated halving - makes quarters and eighths by repeated halving (e.g. locates halfway on a strip of paper then halves each half; finds a quarter of an orange by halving and then halving again; 8 counters halved and then halved again into 4 groups of 2) - identifies the part and the whole in representations of halves, quarters and eighths (e.g. identifies the fractional parts that make up the whole using fraction puzzles) - represents known fractions using various fraction models (e.g. discrete collections, continuous linear and continuous area)	
Progression level 3	Repeating fractional parts - accumulates fractional parts (e.g. knows that two-quarters is inclusive of one-quarter and twice one-quarter, not just the second quarter) - checks the equality of parts by iterating one part to form the whole (e.g. when given a representation of one-quarter of a length and asked, "what fraction is this of the whole length?", uses the length as a counting unit to make the whole) - identifies fractions in measurement situations and solves problems using halves, quarters and eighths (e.g. quarters in an AFL match; uses $2\frac{1}{2}$-cup measures in place of a single one-cup measure) - demonstrates that fractions can be written symbolically and interprets using part-whole knowledge (e.g. interprets $\frac{3}{4}$ to mean 3 one-quarters or 3 lots of $\frac{1}{4}$)	
Progression level 4	Re-imagining the whole - creates thirds by visualising or approximating and adjusting (e.g. imagines a strip of paper in 3 parts, then adjusts and folds) - identifies examples and non-examples of partitioned representations of fractions - divides a whole into different fractional parts for different purposes (e.g. explores the problem of sharing a cake equally between different numbers of guests) - demonstrates that the more parts into which a whole is divided, the smaller the parts become	

Progression level 5	Equivalence of fractions - identifies the need to have equal wholes to compare fractional parts (e.g. compares the pieces of pizza when 2 identical pizzas are cut into 6 and 8 and describes how one-sixth is greater than one-eighth) - creates fractions greater than one by recreating the whole (e.g. when creating four-thirds, demonstrates that three-thirds corresponds to the whole and the fourth third is part of an additional whole) - creates equivalent fractions by dividing the same-sized whole into different parts (e.g. shows two-sixths is the same as one-third of the same whole; creates a fraction wall) - uses partitioning to establish relationships between fractions (e.g. creates one-sixth as one-third of one-half)	4
Progression level 6	Fractions as numbers - connects the concepts of fractions and division: a fraction is a quotient, or a division statement (e.g. two-sixths is the same as $2 \div 6$ or 2 partitioned into 6 equal parts or to solve “how to share 2 chocolate bars equally between 3 people”, understands that it is 2 divided by 3, therefore each person gets two-thirds of a chocolate bar) - justifies where to place fractions on a number line (e.g. to show two-thirds on a number line, divides the space between zero and one into 3 equal parts and indicates the correct location) - uses and explains the equivalence of decimals to benchmark fractions (e.g. $\frac{1}{4} = 0.25$, $\frac{1}{2} = 0.5$, $\frac{3}{4} = 0.75$, $\frac{1}{10} = 0.1$, $\frac{1}{100} = 0.01$; converts cup measures to millilitres)	5
Progression level 7	Comparing fractions - understands the equivalence relationship between a fraction, decimal and percentage as different representations of the same quantity (e.g. $\frac{1}{2} = 0.5 = 50\%$ because 5 is half of 10 and 50 is half of 100) - identifies a fraction as a rational number that has relative size (e.g. describes a position as $\frac{2}{3}$ of the way up a ladder or varies a movement by performing it at half speed; understands “a quarter turn” as turning 90° rather than turning once every four steps) - reasons and uses knowledge of equivalence to compare and order fractions of the same whole (e.g. compares two-thirds and three-quarters of the same collection or whole, by converting them into equivalent fractions of eight-twelfths and nine-twelfths; explains that three-fifths must be greater than four-ninths because three-fifths is greater than a half, and four-ninths is less than a half)	6
Progression level 8	Operating with fractions - adds or subtracts fractions with the same denominators and justifies the need for a common denominator - uses strategies to calculate a fraction of a quantity (e.g. to find a time-point two-thirds of the way through a music video or animation, determines one-third then doubles; locates a position a third of the way across the stage by measuring the width of the stage and dividing by 3) - explains the difference between multiplying and dividing fractions (e.g. recognises $\frac{1}{2} \times \frac{1}{4}$ as one-half of a quarter and $\frac{1}{2} \div \frac{1}{4}$ as how many quarters are in one half) - expresses one quantity as a fraction of another (e.g. 12 defective items from the 96 that were produced represents one-eighth of all items produced) demonstrates why dividing by a fraction can result in a larger number	

Appendix 3: Fractions in NAPLAN proficiency levels

	Needs additional support	Developing	Strong	Exceeding
Year 3	identify halves and quarters of a shape, object or small collection	determine halves, quarters and eighths of a whole read time on a digital and analog clock to the hour and half hour	interpret common fractions as equal parts of a whole and determine a fraction of a shape, object or collection	solve problems involving common fractions
Year 5	determine a simple fraction of a collection	compare fractions and identify the fraction to complete a whole	identify equivalent fractions represent hundredths as decimals solve problems using unit fractions continue number patterns using addition and multiplication with whole numbers, simple fractions and decimals	add and subtract decimals and fractions with the same denominator
Year 7	calculate a simple fraction of a quantity describe the probability of an event, using likelihood and familiar fractions	compare unit fractions identify equivalent fractions calculate a fraction of a quantity and the fraction to complete a whole convert between fractions, decimals and percentages solve single- and multi-step problems involving integers, decimals and fractions with related denominators continue number patterns using addition or subtraction with fractions	calculate fractions and percentages of a quantity solve single- and multi-step problems involving integers, decimals and fractions	connect equivalent fractions, decimals and percentages solve multi-step problems including with integers, fractions, decimals and the combination of operations

Appendix 4: Strategy factsheet — annotated sample

1 Walk the line

Teaching strategies for thinking about fractions

Best for

- Year level: 4
- Fraction construct: Measure

Overview

3	Description	This activity is designed to support students to develop understanding of the measure fraction construct which is foundational in students' development of thinking about fractions. Through the activity, students can be supported to understand: - how the size of the fraction changes depending on the numerator and denominator - the relative size of fractions, including equivalence - how fractions can be used to represent values less than one.
4	Learning focus	Australian Curriculum: Year 4 Mathematics Number - count by fractions including mixed numerals; locate and represent these fractions as numbers on number lines (AC9M4N04) - find equivalent representations of fractions using related denominators and make connections between fractions and decimal notation (AC9M4N03) General capability: Numeracy learning progression Number sense and algebra: Interpreting fractions - equivalence of fractions — creates equivalent fractions by dividing the same-sized whole into different parts (P5) - equivalence of fractions — uses partitioning to establish relationships between fractions (P5) - fractions as numbers — justifies where to place fractions on a number line (P6) - fractions as numbers — uses and explains the equivalence of decimals to benchmark fractions (P6)
5	Teacher preparation	- Consider whether you would like students to complete the activity in small groups or as a class. - Assemble required resources: - rope to fit across the classroom space - a set of fraction cards. - at least 40 pegs.






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For all Queensland schools

Annotations

- 1** Name of strategy.
- 2** Outer ring — a coloured section indicates the fraction construct/s the strategy is most relevant to. Inner ring — the grey circle indicates the year level/s the strategy is best for.
- 3** A brief description of the strategy is provided.
- 4** The learning focus identifies which Mathematics curriculum strand/s and which Numeracy learning progression/s the strategy addresses. In most cases, the strategy can be adapted to suit students at different year or numeracy development levels. Teachers are encouraged to adapt as necessary.
- 5** Preparation for implementing the strategy is suggested.

6

Resource**Walk the line fraction cards**

You may choose to only use a selection of these or create your own.

- Prepare the classroom with rope strung across room. Ensure the height of the rope is low enough for all students to reach.

Example: Activity in progress

7

Suggested implementation

1. Distribute the fraction cards.
2. Direct students to peg their card on the line (when asked).
 - a. Start by placing cards at 0 , $\frac{1}{2}$ and 1 .
 - b. Discuss how you might be able to approximate distances (e.g. length of stride).
3. Call students forward using directives such as: 'If you have a fraction with a three in the denominator, place your number on the number line'. Students may adjust their placements based on feedback from other students.
4. Conclude with a whole class discussion. Consider using the following questions to lead a discussion:
 - a. Who needed to peg their card in the same place as someone else?
 - b. How can we determine the accuracy of our placement?
 - c. Which reference points were the most useful?
 - d. Did anyone consider an equivalent fraction to help them place their card?
 - e. Is it possible for a placement to be reasonable, but not exact?
 - f. Could we extend the number line beyond one? What would this represent?

8

Variation

1. Have students choose different fractions and create their own cards to place on the number line.
2. This activity could be adapted for lower year levels by only using simple fractions, such as halves and quarters.
3. This activity could be adapted for higher year levels by incorporating more challenging fractions, such as sevenths and ninths.

Annotations

6

A blue T or C icon indicates that a downloadable resource (template or set of cards) is available.

7

Step-by-step guidance is provided for implementing the strategy. These are written from the perspective of teacher actions. Where relevant, resources and examples are provided.

8

Where relevant, variations (including for different year levels) are suggested. However, teachers are encouraged to create further adaptations to suit their own context and purposes.

9

References

This activity is inspired by:

Australian Association of Mathematics Teachers. (n.d.). *Sorting fractions cards slide presentation*.
Top drawer teachers: Resources for teachers of mathematics.

<https://topdrawer.aamt.edu.au/Fractions/Downloads/Sorting-fractions-cards-slide-presentation>

YuMi Deadly Centre Faculty of Education. (2014). *YuMi Deadly Maths Year 4 Teacher Resource: NA – Walking the rope*. QUT. https://research.qut.edu.au/ydc/wp-content/uploads/sites/181/2017/12/YDM-CCP14_Year4_NA_Walking_the_rope.pdf

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Annotations

9

Where relevant, suggestions about additional resources and readings are provided.

10

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