Using number lines to enhance number sense in Years 4–6

Factsheet

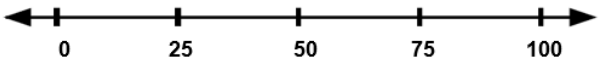
Key messages

Number lines are important tools for enhancing students' number sense. Incorporating number lines in teaching and learning promotes the active construction of mathematical meaning by strengthening students' mental representations of number magnitude, number relationships and mathematical operations.

Number lines are based on measuring from a fixed point. This requires a shift in thinking from a counting model that focuses on the number of objects in a set to a measurement model that counts units of length. This shift in thinking means that students require explicit and systematic teaching about number lines.

There is a strong correlation between a deep understanding of number lines and the development of more advanced mathematical concepts. Number lines are also an important aspect of the numeracy knowledge and skills that people require to function well in the world. This factsheet provides key considerations for instruction with number lines to promote students' active construction of mathematical meaning

Whole numbers



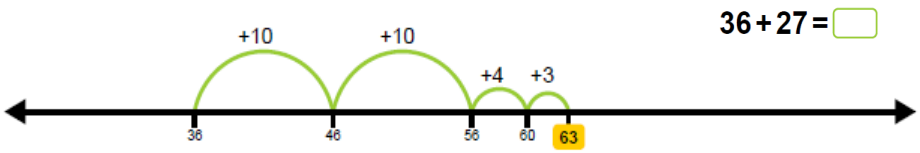
Students require a deep understanding of the structure and use of the number line for whole numbers prior to applying it to other number contexts. Students draw on their knowledge of the number system and sense of number order, magnitude and proportionality to successfully work with numbers on the number line.

Having students work together to establish benchmark values supports them to create a powerful visualisation of number relationships. For example, benchmark values such as 25, 50 and 75 provide students with reference points when locating other numbers on an open number line between 0 and 100. Benchmarks also provide a strong foundation for working with open number lines to order and operate with numbers.

Further details, including a suggested teaching and learning sequence, are provided in the resource *Using number lines to enhance number sense in Prep – Year 3*.

Operating with whole numbers on the number line

A number line is an important tool for modelling strategies in addition and subtraction.
The open number line can be used to visualise the steps taken to perform a number operation.
As strategies become more sophisticated, the number of jumps should decrease.

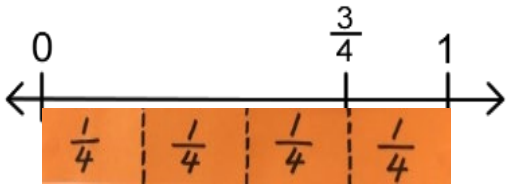


Give students the freedom to produce their own strategies. Then support them to share strategies and discuss the strengths of various solutions to highlight more efficient and reliable strategies and procedures.

Fractions

Thinking of a fraction as a number is critical for developing fraction sense. However, students may find fraction number lines conceptually difficult.

Linear representations, such as paper strips or string, are useful for promoting visualisation and conceptual understanding of fractions as numbers on a number line. Students require a range of experiences with fractions on the number line.

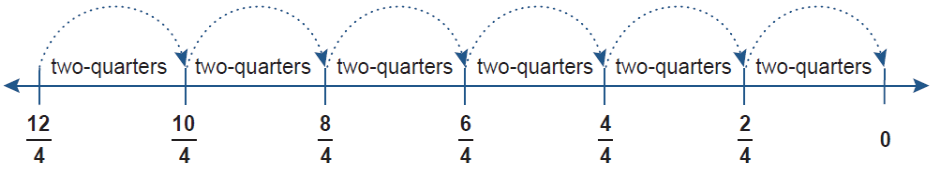


To begin, focus on fractions that fall between 0 and 1: partitioning lines to create fractions, counting in fractions, establishing benchmark values and identifying missing fractions on a number line. These experiences help students visualise fractional quantities and equivalences and locate fractions on a number line.

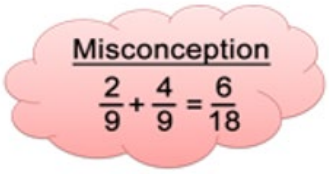
Build on this by explicitly working through similar experiences with fractions beyond 1.

Operating with fractions on the number line

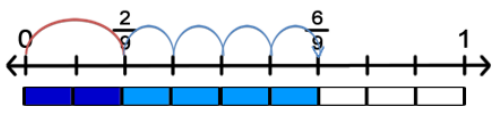
Initial experiences with operating with fractions on the number line occur as students continue counting patterns by adding and subtracting fractions on a structured number line with marked segments.



Students may develop misconceptions when operating with fractions if they haven't had enough experience and practice to develop their conceptual understanding. For example, they may treat the numerators and denominators as separate whole numbers to add fractions.



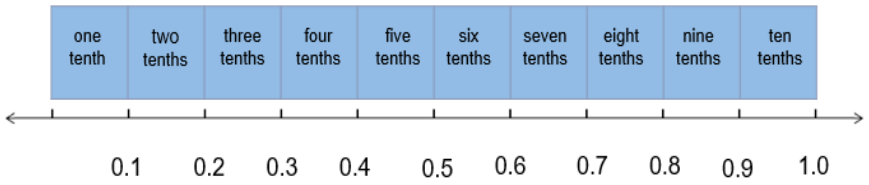
Support students to develop deep understanding by modelling addition and subtraction of fractions with the same denominators on a number line. Relate this process to previously used linear representations. Progress students to operating with related denominators and then working on an open number line through modelling and practice.



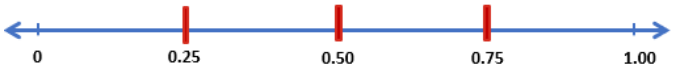
$$\frac{2}{9} + \frac{4}{9} = \frac{6}{9}$$

Decimals

A linear representation, such as a strip of tenths, is effective in physically establishing the link between fraction and decimal notations and their positions on a number line.



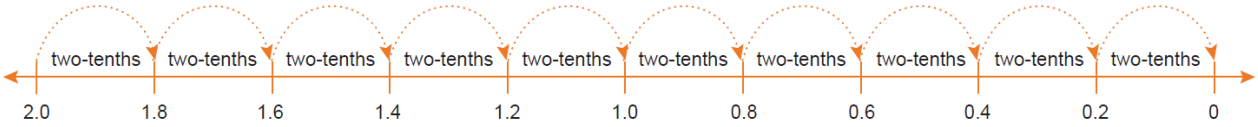
Support students' decimal understanding through experiences to develop a visual representation of the relative size and position of decimal numbers.



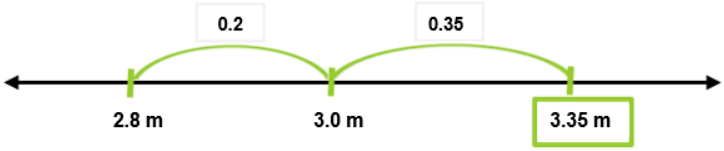
Encourage the use of partitioning strategies to locate common points of reference.

Operating with decimals on the number line

Use a similar progression to that used with fractions. Initial experiences may involve continuing counting patterns by adding and subtracting decimals on a structured number line with marked segments.



Students progress to operating on an open number line using understanding of partitioning, equivalences and referents as in the example below.



At the athletics carnival I jumped 2.8m in long jump. The teacher said I need to jump 0.55m further to break the record.

How far do I need to jump?

Integers

Integers include zero, whole (positive) numbers and their opposites — negative numbers.

Without a clear concept of number as a system of both direction and magnitude, students may struggle to deal with negative numbers (Cambridge Mathematics 2018).

To support students' conceptual development, it is important to incorporate real-world contexts such as temperatures, building floors and bank balances.

Initially have students create large-scale integer number lines and use these to explore everyday contexts (such as the one in the example right) by locating key integers involved in a problem and then moving along the line to demonstrate the action.

> Dad and I are in basement 2 (–2) of a shop looking at computer games. We plan to meet mum at the cafe on floor 5.
>
> How many floors of stairs will we have to climb?

References

The Australian Association of Mathematics Teachers Inc., 'Number lines', www.aamt.edu.au/Topdrawer/Patterns/Misunderstandings/Number-lines

Cambridge Mathematics 2018, 'What does research suggest about effective ways to introduce negative numbers?', *Cambridge Mathematics Espresso*, issue 15, www.cambridgemaths.org/Images/espresso_15_introducing_negative_numbers.pdf

Frykholm, J 2010, *Learning to Think Mathematically with the Number Line: A resource for teachers, a tool for young children*, The Math Learning Center, USA, www.mathlearningcenter.org/sites/default/files/pdfs/LTM_Numberline.pdf

Siemon, D, Beswick, K, Brady, K, Clark, J, Faragher, R & Warren, E 2015, *Teaching Mathematics: Foundations to middle years*, 2nd edn, Oxford University Press, Melbourne.

Western Australia Department of Education 2013, 'Number — Book 1: Understand whole and decimal numbers, understand fractional numbers', *First Steps Mathematics*, https://myresources.education.wa.edu.au/programs/first-steps-mathematics/number