Part 5: comparing, ordering, sequencing and estimating

About the resource

This resource the fifth section of a 6-part resource supporting number knowledge. Use this resource is conjunction with other guides to support a connected network of critical mathematical concepts, skills and understanding.

The resource has been developed in partnership with the NSW Mathematics Strategy Professional Learning team, Curriculum Early Years and Primary Learners, and Literacy and numeracy.

We use numbers to describe the world around us.

Understanding how numbers work is a critical part of developing deep, meaningful mathematical skills, understanding and confidence. This includes the use of flexible additive strategies which are a direct by-product of a student's number sense.

Like most things in mathematics, talking about number is hard to do without referring to other aspects such as patterns, subitising, counting, fractions, the operations, measurement, statistics. As such, this resource is best used in conjunction with other guides to support a connected network of critical mathematical concepts, skills and understanding.

- Part 1: Connecting number names, numerals and quantities
- Part 2: Building important relationships - part-part-whole
- Part 3: Building important relationships - more than, less than, equivalent in value to
- Part 4: Benchmarks of 5 and 10
- **Part 5: Comparing, ordering, sequencing and estimating**
- Part 6: Building place value (including renaming)

Syllabus

MAO-WM-01 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

MAE-RWN-01 demonstrates an understanding of how whole numbers indicate quantity

MAE-RWN-02 reads numerals and represents whole numbers to at least 20

MAE-CSQ-01 reasons about number relations to model addition and subtraction by combining and separating, and comparing collections

MAE-CSQ-02 represents the relations between the parts that form the whole, with numbers up to 10

MAE-GM-02 describes and compares lengths

MAE-2DS-02 describes and compares areas of similar shapes

MA1-RWN-01 applies an understanding of place value and the role of zero to read, write and order two- and three-digit numbers

MA1-RWN-02 reasons about representations of whole numbers to 1000, partitioning numbers to use and record quantity values

MA1-CSQ-01 uses number bonds and the relationship between addition and subtraction to solve problems involving partitioning

MA1-GM-02 measures, records, compares and estimates lengths and distances using uniform informal units, as well as metres and centimetres

NSW Mathematics K-10 Syllabus (2022)

Progression

Number and place value NPV1-NPV3

Counting processes CPr1-CPr7

Additive strategies AdS1-AdS2

Understanding units of measurement UuM2-UuM4

National Numeracy Learning Progression (NNLP) Version 3

How to use the resource

Teachers can use assessment information to make decisions about when and how they use this resource as they design teaching and learning sequences to meet the learning needs of their students.

The tasks and information in the resource includes explicit teaching, high expectations, effective feedback and assessment and can be embedded in the teaching and learning cycle.

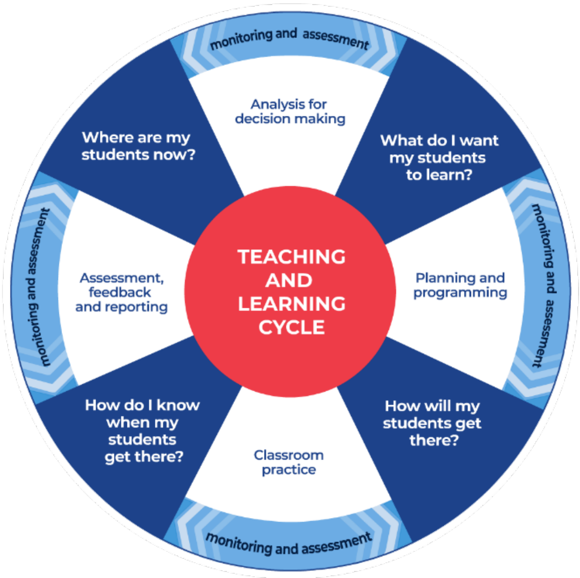

Figure 1: Teaching and learning cycle

- **Where are my students now?** Teacher uses a range of assessment information to determine what students know and can do, including their interests, learning strengths and needs.
- **What do I want my students to learn?** Teachers use the information gathered along with the syllabus and NNLP to determine the next steps for learning. Teachers might also like to look at the ‘what’s some of the maths’ and ‘key generalisations’ to synthesise the information they have gathered into the next step/s for learning.
- **How will my students get there?** Teachers can then use the task overview information (‘What does it promote?’ and ‘What other tasks can I make connections to?’) to find tasks that meet the learning needs of students. Teachers then make decisions about what instructional practices and lesson structures to use in order to best support student learning. Further support with [What works best in practice] is available.
- **How do I know when my students get there?** Teachers can use the section ‘Some observable behaviours you may look for/notice’ that have been articulated for each task as a springboard for what to look for. These ideas can be used to co-construct success criteria and modified to suit the learning needs, abilities and interests of students. Referring back to the syllabus and the NNLP are also helpful in determining student learning progress as well as monitoring student thinking during the task. The information gained will inform ‘where are my students now’ and ‘what do I want them to learn’ as part of the iterative nature of the teaching and learning cycle.

Overview of tasks

Task name	What does it promote?	What other tasks can I make connections to?	What materials will I need?	Possible group size
Domino Flip	Comparing quantities to determine more, less or the same.	Order! Order! 1 Order! Order! 2	• dominos	Small group
About how many paperclips?	Using relevant information to estimate and refine thinking to be able to offer a reasonable estimate of 'how many'.	Minute to win it (ABC Education)	• Writing materials • Paperclips	Whole class and/or small group
About how many rectangles?	Using relevant information to estimate and refine thinking to be able to offer a reasonable estimate of 'how many'.	Tangram puzzles	• Writing materials	Whole class or small group
Bean Counter	Using relevant information to estimate and refine thinking to be able to offer a reasonable estimate of 'how many'.	A jar of teddies (NRICH maths) Estimating dots (youcubed)	• Dry beans or counters • Transparent jars (more than 10)	Whole class or small group

Domino flip

Key generalisations / what's (some of) the mathematics?

- Numbers (quantities) can be compared.
- Quantities can be 'more than', 'less than' or 'equivalent' to other quantities.
- Knowing the number naming sequence can help us to determine how much bigger or smaller one collection is in relation to a second collection.
- Dominos are an example of familiar structure or pattern we can use to quantify collections.
- Mathematicians know they can trust mathematical regularities like domino patterns and the number naming sequence.

Teaching point: From early on, children visually compare quantities to determine which has more or less items. This can be seen when they protest there has been an unfair share at snack time - "Sam has more than me!". This visual comparison works well when the quantities being compared are either very small so we can subitise them or when they are distinctly very different amounts, for example, 8 strawberries look distinctly smaller than 20 strawberries. In this task, when students turn over a domino beyond their subitising range or not distinctly different in quantity, then students may use their knowledge of the order of numbers to determine which has less or more. For example, they may explain "There is 7 on this domino and 5 on the other. Seven is more because 7 comes after 5 when we count, look, 5, 6, 7".

Some observable behaviours you may look for/notice:

- Conceptually subitises by identifying patterns in standard representations (for example, recognises a collection of seven items as a result of perceptually subitising smaller parts 5 and 2 on a domino)
- Identifies a quantity as a result of combining smaller parts (uses part-part-whole knowledge to determine how many)
- Uses knowledge such as the flexibility of numbers, part-part-whole, known facts, doubles, familiar patterns and strategies to determine how many in a collection
- Uses counting to determine how many
- Visualises dots moving from one domino to another to answer the question 'how many?'
- Determines who has more or less by looking and thinking. For example, "I have a 5 and a 4 on my domino and you have 4 and a 4 so I must have one more than you"
- Compares collections using comparative language such as more, less, bigger, smaller, equivalent, and so on.
- Identifies how much bigger or smaller a collection is by describing the difference. For example, I have 9 on my domino and Jack has 7, I have 2 more than Jack
- Analyses the game and explains possible dominos needed to win the round.

Materials

- Dominos

Instructions

1. Teams flip over one domino each, compare the quantities and then the highest (or lowest) quantity wins that round.
2. Take a counter for a win.
3. The player with the most counters at the end of a game of, for example 10 rounds, wins.

Variations

- Record the difference, the student with the largest (or smallest) difference at the end of 5 (or another chosen number) of rounds is the winner.
- Vary the domino number range.

About how many paper clips?

Key generalisations / what’s (some of) the mathematics?

- There are protocols we can follow to help us measure accurately. For example, I can use the same unit, end to end with no gaps or overlaps, to determine how long something is.
- We have to use units of the same size if we want to create an accurate measurement.
- The smaller the unit, the more I will need to measure something.

Teaching point: Providing multiple, meaningful experiences in estimating will help students develop increasingly reasonable estimating skills. It is important estimates are not judged as ‘right’ or ‘wrong’ since they were never intended to provide an exact response. Instead, teachers should support students to talk about estimates as being reasonable or something they would like to revise now they have considered other evidence.

When estimating measures, teachers can help students identify various attributes that can be used to measure, using both language and gesture. For example, we could measure a container by how long it is, how tall it is, how much it can hold or how much it weighs.

Some observable behaviours you may look for/notice:

- Sorts objects based on the attribute of length
- Estimates by imagining how many paperclips could be used to measure the length of the piece of paper
- Adjusts estimates when provided with additional information
- Explains when measuring we need to use items of the same size to have a valid unit
- Determines the last number said describes the total of that collection
- Explains when measuring accurately we must make sure there are no gaps or overlaps
- Notices mathematical relationships (for example, for each 2 big paper clips there are 3 smaller paperclips)
- Uses mathematical relationships. For example, “I see two large paperclips are equivalent in length to three smaller paperclips. I think I will need 4 more big paper clips so that would mean another 6 small paperclips to measure the length of the edge”
- Uses known facts to determine how many there are in a collection.

Materials

- Writing materials
- Paperclips

Possible group size

Whole class or small group

Instructions

There are 2 parts to this activity. View About how many paper clips? and use the questioning to guide student thinking.

Part 1: Have students draw their estimation of how many small paper clips it will take to measure the length of the paper

Have students discuss - What did you notice?

Part 2: Have students discuss - What did you notice?

About how many rectangles?

Key generalisations / what's (some of) the mathematics?

- I can use my mathematical imagination to visualise and shapes flipping, turning or repeating to help solve problems.
- When I halve the size of the unit, I then need to double the quantity I need to fill the same space (the smaller the unit, the more I will need to measure something).
- Mathematicians use what they know about relationships to solve problems.

Some observable behaviours you may look for/notice:

- Makes reasonable estimates
- Adjusts estimates when provided with additional information
- Explains when measuring accurately we must make sure there are no gaps or overlaps
- Describes how much space one shape or objects might take up using language and gesturing. For example, "I imagine it's going to be the same on the other side because this looks like it's about halfway"
- Uses paper folding to check thinking
- Notices mathematical relationships (for example, for each bigger rectangle occupies the same space as 2 smaller rectangles)
- Uses known facts to determine how many.

Materials

- Writing materials

Possible group size

Whole class or small group

Instructions

There are 2 parts to this activity. View About how many rectangles? and use the questioning to guide student thinking.

Part 1: Ask students: About how many of the smaller orange rectangles are needed to fill the area of the large dark blue rectangle?" Have students draw a picture to share their thinking.

Part 2: Have students discuss what they discovered about how many orange rectangles are needed to cover the larger blue rectangle. Did they notice similar things?

Bean counter

Key generalisations / what's (some of) the mathematics?

- The total of a collection can be estimated by looking and thinking, using what is known about familiar objects, familiar spatial patterns, familiar number facts and combining strategies.
- Using structures can help us compare the size of collections.
- Some arrangements/structures allow us to determine 'how many' with greater efficiency than other arrangements.
- In our number system, every time we collect 10 of something, we regroup and rename it. This is a kind of pattern. For example, 10 ones is renamed as 1 ten; 10 hundreds is renamed as 1 hundred.
- Mathematicians use what they know about numbers to provide reasonable estimates.
- Mathematicians revise their thinking when they are presented with new information.

Teaching point: The need to understand forward and backward number word sequences continues to be important beyond the early years of schooling. Due to the complexity of English, special attention is needed to support students in recognising where the patterns in the counting words 're-start' as they cross the decades and the centuries. This is where counting in tens and renaming alongside reciting the number words can support student understanding. For example, counting… 15 tens (150), 14 tens (140), 13 tens (130), 12 tens (120), 11 tens (110), 10 tens (100), 9 tens (90).and so on.

Some observable behaviours you may look for/notice

- Imagines how many objects are in a collection, looking and feeling only
- Suggests a reasonable estimate
- Adjusts estimates when provided with additional information
- Uses structure to organise a quantity by purposefully grouping resources to determine and/or prove 'how many'. For example, structures beans into ten-frames to determine there are 3 tens and 4 more which is 34 in total
- Describes when counting, every time we get a collection of 10 ones we group then and name it as 1 ten
- Counts collections and uses renaming to determine 'how many?' For examples, counts tens "1 ten, 2 tens, 3 tens, 4 tens that's forty)
- Counts forwards using composite units to determine 'how many?' For example, counts "ten, twenty, thirty, forty, there are forty"
- Understands each number word said when counting by tens represents a collection of ten
- Explains the suffix '-ty' means 'groups of ten'
- Uses known facts to determine how many.

Materials

- Large quantity of dry beans (or other materials like counters)
- Approximately 10 transparent containers/jars

Instructions

1. Present students with a large quantity of dry beans or other similar material that can be stored in small containers.
2. Ask students to estimate the number of beans, justifying their estimations and sharing their thinking. Record their estimations on the board.
3. Have students count out 10 beans and place the 10 beans next to the larger collection. Ask students to talk to a thinking partner about their initial estimate and whether they would now revise their estimate, and to what number.
4. Share ideas and discuss the various ways students used the comparison to 10 to help them refine their estimates.
5. Provide a small container to students. Place the 10 beans inside the container, explaining since we've grouped them together, we will call them '1 ten'. Have the students make groups of ten, adding each group into a different container.
6. Determine how many tens there are and how many are left over. Together, count by tens by saying, for example, '1 ten', '2 tens', '3 tens', '4 tens', '5 tens', '5 tens and…3 more ones'.
7. Discuss how many beans there are in total and how you could record that amount. The teacher should encourage to the students to see 5 tens and 3 ones can also be written as 53, 'fifty-three', 50 and 3 more, and so on.

Variations

- Use the collection to practise counting forwards and backwards by 10, on and off the decade. For example, '5 tens and 3 ones, 4 tens and 3 ones, 3 tens and 3 ones, 2 tens and 3 ones, 1 ten and 3 ones, 3 ones' as each ten is hidden from view as well as saying the number words.
- Once the beans have been organised, 'race' the students to work out the total with the students counting in the most efficient way and the teacher counting by ones. Use this to discuss why we count in multiples.
- Have students represent the amount of beans in other efficient ways such as making an array or grouping 10 tens into 1.

Reference list

Mathematics K–10 Syllabus © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

National Numeracy Learning Progression © Australian Curriculum, Assessment and Reporting Authority (ACARA) 2010 to present, unless otherwise indicated. This material was downloaded from the Australian Curriculum website (National Literacy Learning Progression) (accessed 6 November 2023) and was not modified.

Australian Broadcasting Corporation Education (2021) 'Maths Years 3–4 with Ms Kirszman: Quantifying collections', Australian Broadcasting Corporation website, accessed 20 November 2023.

Stanford University (n.d.) 'Estimating dots', Resources, youcubed website, accessed 20 November 2023.

State of New South Wales (Department of Education) (2023) 'About how many paper clips?', Mathematics K-6 resources, NSW Department of Education website, accessed 20 November 2023.

State of New South Wales (Department of Education) (2023) 'About how many rectangles?', Mathematics K-6 resources, NSW Department of Education website, accessed 20 November 2023.

State of New South Wales (Department of Education) (2023) 'Order! Order! 1', Mathematics K-6 resources, NSW Department of Education website, accessed 20 November 2023.

State of New South Wales (Department of Education) (2023) 'Order! Order! 2', Mathematics K-6 resources, NSW Department of Education website, accessed 20 November 2023.

State of New South Wales (Department of Education) (2023) 'Tangram puzzles', Mathematics K-6 resources, NSW Department of Education website, accessed 20 November 2023.

University of Cambridge (Faculty of Mathematics) (1997–2023) A jar of teddies, NRICH website, accessed 20 November 2023.

Copyright

Evidence base

Sparrow, L., Booker, G., Swan, P., Bond, D. (2015). *Teaching Primary Mathematics*. Australia: Pearson Australia.
Brady, K., Faragher, R., Clark, J., Beswick, K., Warren, E., Siemon, D. (2015). *Teaching Mathematics: Foundations to Middle Years*. Australia: Oxford University Press.

Alignment to system priorities and/or needs: The literacy and numeracy five priorities.

Alignment to School Excellence Framework: Learning domain: Curriculum, Teaching domain: Effective classroom practice and Professional standards

Consulted with: NSW Mathematics Strategy professional learning and Curriculum Early Years Primary Learners-Mathematics teams

Reviewed by: Literacy and Numeracy

Created/last updated: January 2024

Anticipated resource review date: January 2025

Feedback: Complete the online form to provide any feedback.