Northbridge Public School

Mathematics

Calculation Strategies Guide

Aligned with the NSW Mathematics Syllabus 2012

When solving a maths calculation, I ask myself...

Can I do this in my head?

Can I do this in my head using *drawings* or *jottings* to help me?

Do I need to use a written method? *Which one should I use?*

Should I use a calculator?

Rationale

At Northbridge Public School, students are given the opportunity to become independent and skilled mathematicians. To achieve this, it is important that children understand different calculation strategies for the four operations of mathematics: addition, subtraction, multiplication and division. In mathematics, students are encouraged to analyse a given calculation and effectively choose the most efficient strategy to help them solve it.

Aims

This guide contains the key progressive methods for teaching calculation throughout the school stages.

This guide focuses on written procedures for calculation. However, it is important to recognise that the ability to calculate mentally is an important skill in mathematics.

At school, students are encouraged to support their mental calculation with written recordings that complement their thinking. Written recordings help students to clarify their thinking and extend their development of more fluent and sophisticated mental strategies. They also support teachers in assessing a student's current knowledge and the 'where to next' in their academic progress.

The orders of the following strategies are designed to complement student's prior knowledge. Children are not discouraged from using previously taught methods once new concepts are introduced.

When solving calculations students should be encouraged to think; Can I do this in my head? Should I use drawings or jottings to help me? Do I need to use a written strategy? Or should I use a calculator?

The long-term aim is for students to become competent mathematicians who are able to select an efficient method of their choice that is appropriate for a given task.

How to Use This Guide

The following grids outline the progressive objectives for manipulatives, mental, and pen and paper calculation strategies in calculations of addition, subtraction, multiplication and division.

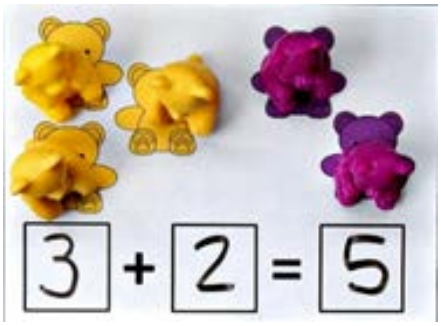
It is important that students gain competency in earlier strategies, enabling them to develop numerical understanding, before being introduced to algorithms that are more formal.

This guide has been produced using the NSW Mathematics syllabus and align with stage group expectations. The stage expectations are to be used as a guide. Students may be working below or above their age expectation.

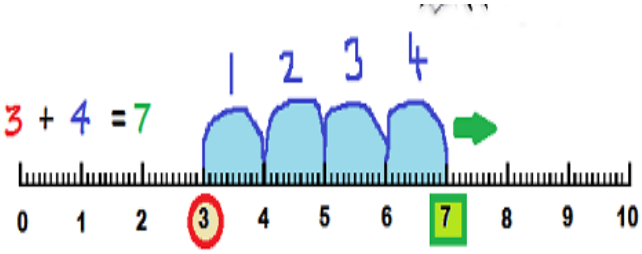
This guide has not been designed to replace the Mathematics syllabus when creating lesson plans, but instead should be used to complement it.

Addition Strategies

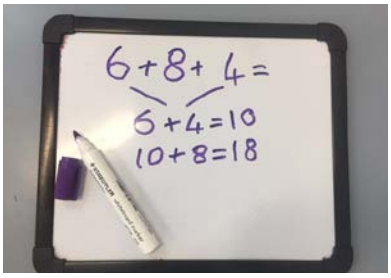
You can use **concrete materials** to help you manipulate an addition calculation.



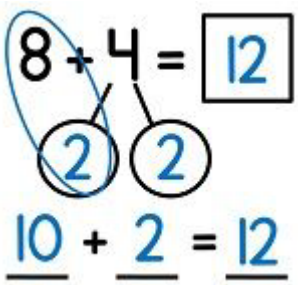
Using the **numberline strategy** can help you with your counting sequence.
Try and start from the biggest number in your calculation.



When you have learnt your number bonds to 10, you can use this knowledge to help you with the **Changing the order of the addends** strategy.
The sum of the calculation does not change when you change the order.

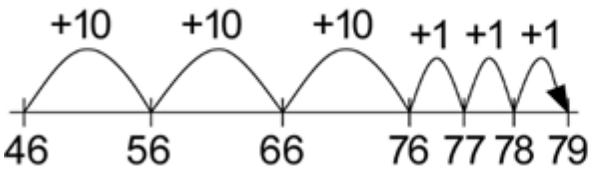


You can also use your number bonds to 10 with the **Bridging to 10** strategy.



Addition Strategies

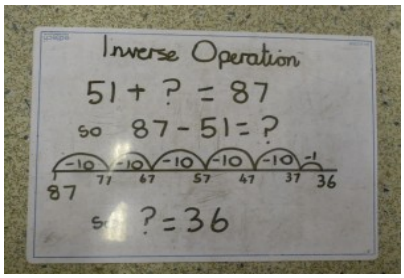
When you are fluent with adding 10, you can use the **jump strategy** on an empty numberline.
Add the 10's separately or try adding them in one big jump.



As you get better at understanding place value, you can use this knowledge to do the **split strategy.**
Add the tens together first and then the ones.

$$16 + 23$$
$$=$$
$$10 + 6 + 20 + 3$$
$$=$$
$$10 + 20 + 6 + 3$$
$$=$$
$$30 + 9$$
$$=$$
$$39$$

You can transfer your understanding of the relationship between addition and subtraction to use the **inverse strategy**.
This is particularly helpful in missing number calculations.



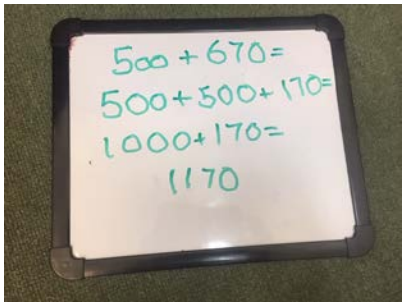
You can use your rounding skills to help you with the **compensation strategy**.
When you round one number to 10 (or 100), you need to adjust your answer to compensate for the change.

Rounded

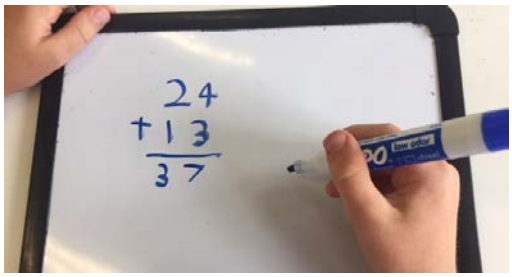
$$37 + 28 = 37 + 30 - 2$$
$$= 67 - 2 \quad \text{Adjusted}$$
$$= 65$$

Addition Strategies

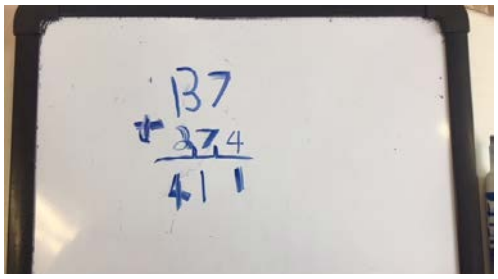
Rather than partitioning numbers into their hundreds, tens and ones, you can use the **non-standard partitioning strategy** to make solving some calculations faster.



When you have an in-depth knowledge of place value and additive strategies, you can do calculations faster by using the formal algorithm to record workings. This is the **decomposition strategy**.
Start with the ones column and work towards the left.



The formal algorithm can become confusing if the digits in each column add up to more than 9. To solve these calculations you will need to do the **decomposition with trading strategy.**
Always remember to add on the number that you have traded across to the next column.

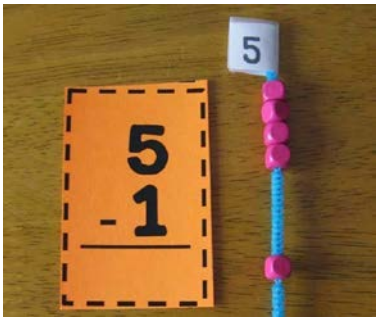


Addition Vocabulary:

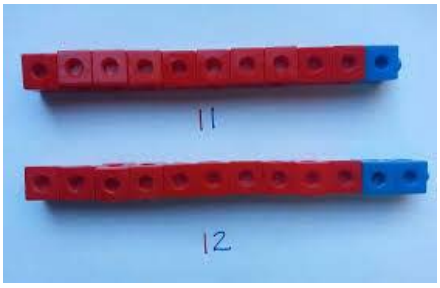
plus, sum, add, addition, increase

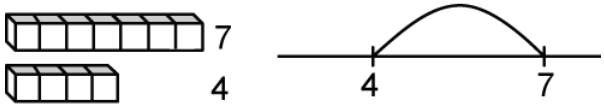
Subtraction Strategies

Model subtraction by separating and taking away part of a group of objects using **concrete materials.**



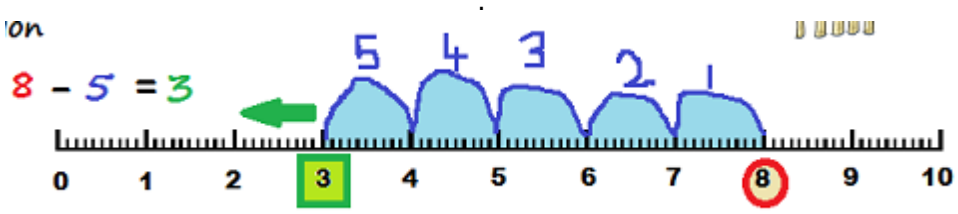
You can subtract a smaller number from another by modelling and **finding the difference** between those two numbers.





The difference between 7 and 4 is 3.

Using the **numberline strategy** can help you with your counting sequence when counting backwards by ones



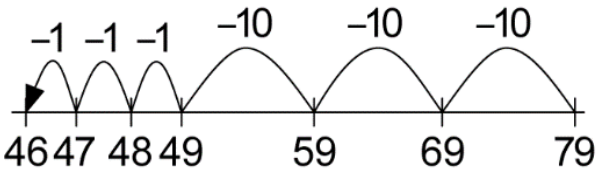
You can transfer your understanding of the relationship between subtraction and addition to use the **inverse strategy**. This is particularly helpful in missing number calculations.

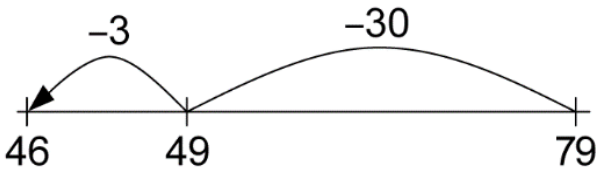
? - 9 = 19

? = 19 + 9

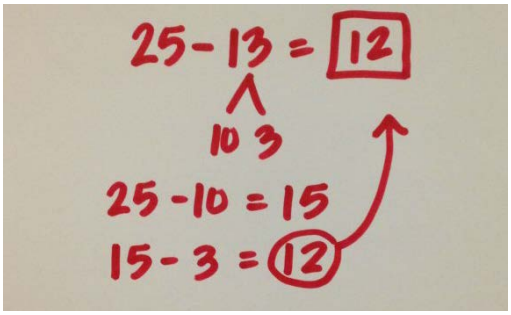
Subtraction Strategies

When you are fluent with subtracting 10, you can use the **jump strategy** on an empty numberline.
Start on the right hand side and subtract the 10's separately or try subtracting them in one big jump.





As you get better at understanding place value, you can use this knowledge to do the **split strategy.**
When subtracting using the split strategy you can keep the first number whole.



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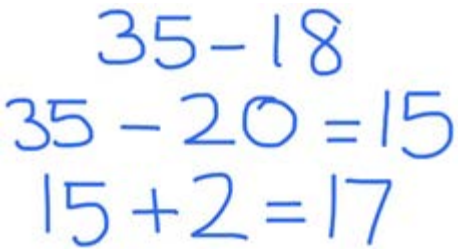
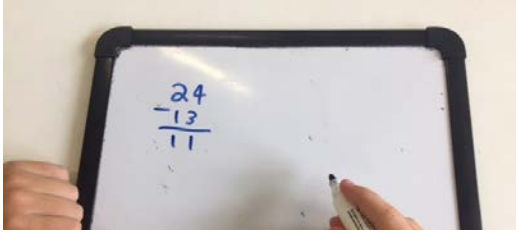
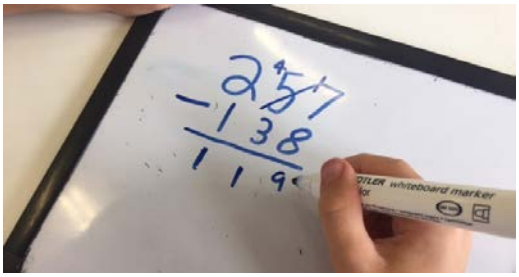


When you have an in-depth knowledge of place value and subtractive strategies, you can do calculations faster by using the formal algorithm to record workings.
This is the **decomposition strategy**.
Start with the ones column and work towards the left.



Subtraction Strategies

The formal algorithm can become confusing if the digit in the underneath number is higher than the top. To solve these calculations you will need to do the **decomposition with trading strategy.**
Remember to include the number that you have traded across to the next column in your addition.

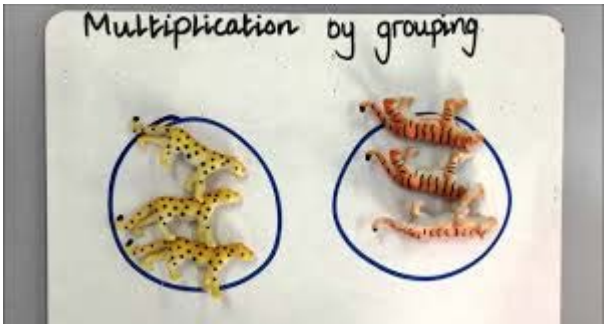


Subtraction Vocabulary:

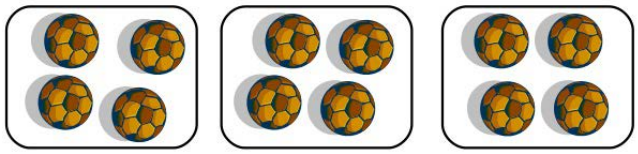
minus, the difference between, subtract, subtraction, decrease

Multiplication Strategies

Model equal groups by grouping **concrete materials** to solve calculations.

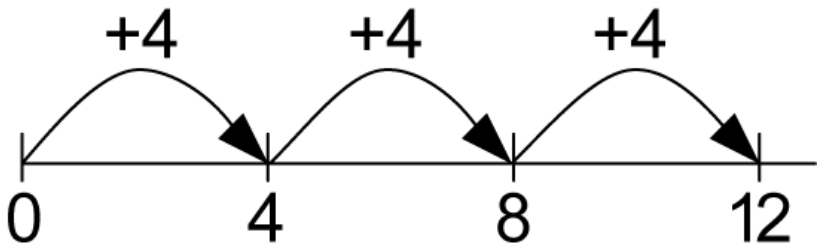


You can use your knowledge of addition to solve multiplication calculations using the **repeated addition strategy.**

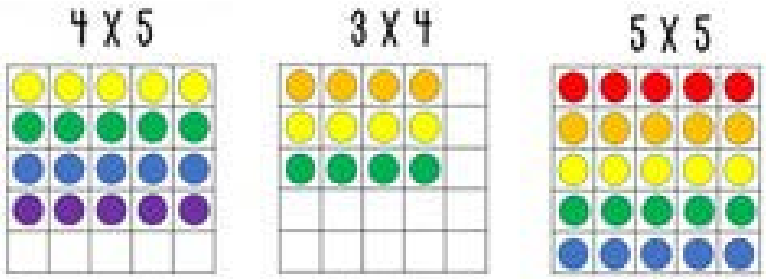


4 + 4 + 4 = 12

Being able to skip count and using the repeated addition strategy can support you in using an empty **numberline** to solve calculations.



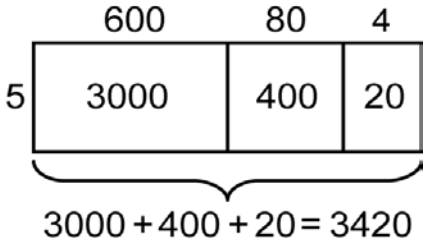
Setting out multiplication calculations as rows and columns using either concrete materials or pictorial representations means you are using the **array strategy.**



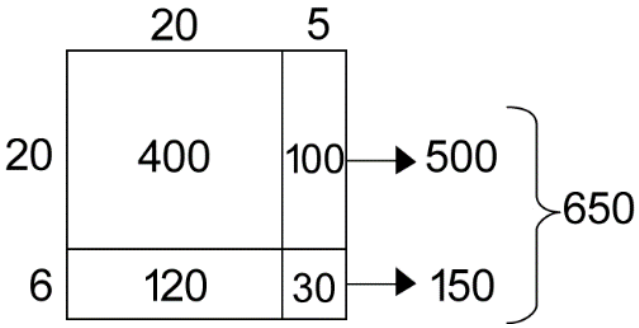
Multiplication Strategies

When you are confident in place value concepts, this knowledge can be used to support you in using an **area model** to solve bigger calculations.

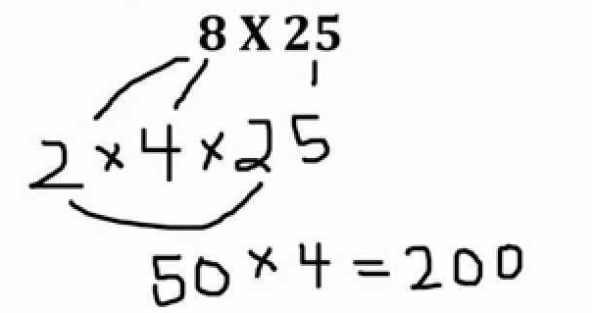
684 X 5 = 3420



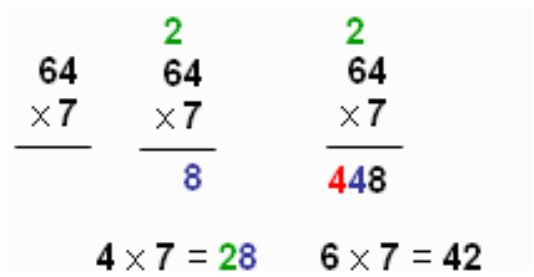
The **extended area model** can be utilised when multiplying two digit numbers together.



Understanding factors of numbers can support you in using the **factorising the numbers strategy**.

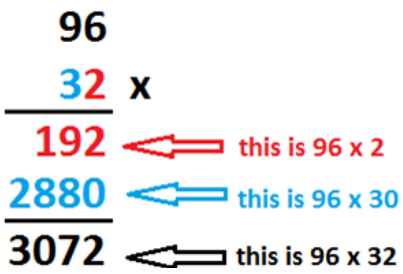


When you have an in-depth knowledge of place value and multiplicative strategies, you can do calculations faster by using the formal algorithm to record workings. This is the **short multiplication strategy**.



Multiplication Strategies

The extended form of the formal algorithm can be utilised when multiplying two digit numbers together. This is the **long multiplication strategy.**



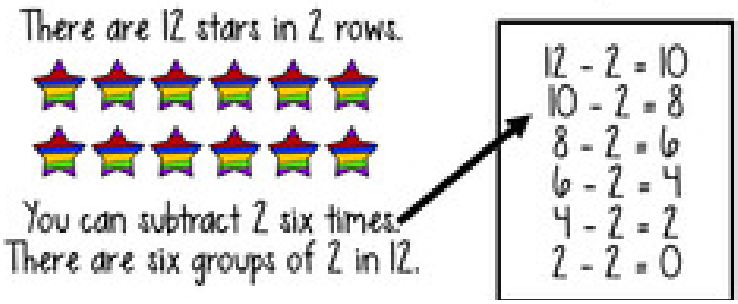
Multiplication Vocabulary:

group, number of groups, number in each group, multiply, multiplied by, product, multiplication, multiplication facts, multiple, factor

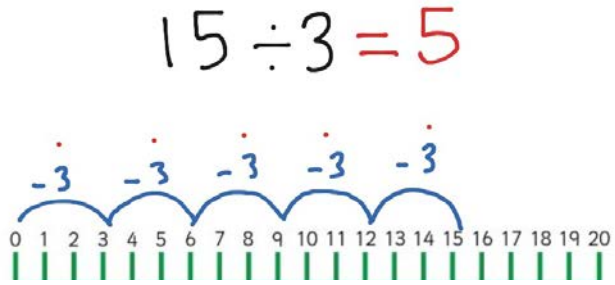
Division Strategies

Model equal sharing by grouping **concrete materials** to solve calculations.

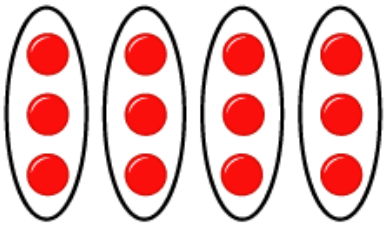
You can use your knowledge of subtraction to solve division calculations using the **repeated subtraction strategy.**



Being able to skip count backwards and using the repeated subtraction strategy can support you in using an empty **numberline** to solve calculations.



Organising the calculation into **groups of equal sets** can help you to count the number of groups.



12 ÷ 3 = 4

Division Strategies

You can use your ability to recall multiplication facts to apply the **inverse relationship** to division to justify answers.

If you know that $6 \times 3 = 18$ then, you know that $18 \div 6 = 3$

and that $18 \div 3 = 6$

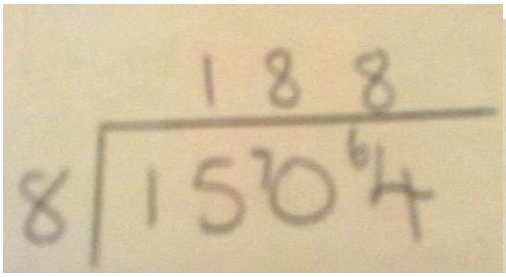
When you have a good understanding of place value, you can use standard and non-standard **partitioning** to split numbers up so you can utilise your knowledge of division facts.

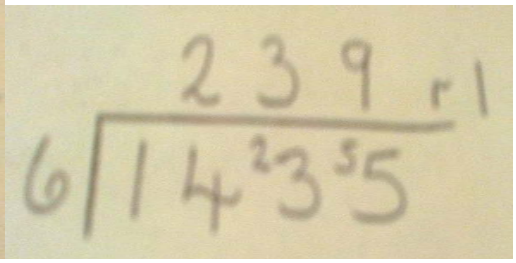
$54 \div 3 =$

$30 + 24$

$10 + 8 = 18$

When you have an in-depth knowledge of place value and multiplicative strategies, you can do calculations faster by using the formal algorithm to record workings. This is the **short division strategy**.





Division Vocabulary:

share, shared between, shared equally, part left over, factor, divide, divided by, division, halve, remainder, quotient, divisor, dividend

BODMAS (Stage 3)

The order in which we carry out a calculation is important, BODMAS is a way of remembering the order of operations.

B **Brackets ( )**

$10 \times (2 + 6) = 10 \times 8 = 80$

O **Order n^2 - Also known as Indices.**

$10 + 3^2 = 10 + 9 = 19$

D **Division ÷**

$10 - 8 \div 2 = 10 - 4 = 6$

M **Multiplication x**

$6 + 3 \times 2 = 6 + 6 = 12$

A **Addition +**

$6 + 3 \times 2 = 6 + 6 = 12$

S **Subtraction -**

$10 - 8 \div 2 = 10 - 4 = 6$

Addition and Subtraction Syllabus Outcomes

Early Stage 1 – Kindergarten
MAe-5NA
combines, separates and compares collections of objects, describes using everyday language, and records using informal methods

Stage 1 – Years 1 and 2
MA1-5NA
uses a range of strategies and informal recording methods for addition and subtraction involving one- and two-digit numbers

Stage 2 – Years 3 and 4
MA2-5NA
uses mental and written strategies for addition and subtraction involving two-, three-, four- and five-digit numbers

Stage 3 – Years 5 and 6
MA3-5NA
selects and applies appropriate strategies for addition and subtraction with counting numbers of any size

Multiplication and Division Syllabus Outcomes

Early Stage 1 – Kindergarten
MAe-6NA
groups, shares and counts collections of objects, describes using everyday language, and records using informal methods

Stage 1 – Years 1 and 2
MA1-6NA
uses a range of mental strategies and concrete materials for multiplication and division

Stage 2 – Years 3 and 4
MA2-6NA
uses mental and informal written strategies for multiplication and division

Stage 3 – Years 5 and 6
MA3-6NA
selects and applies appropriate strategies for multiplication and division, and applies the order of operations to calculations involving more than one operation