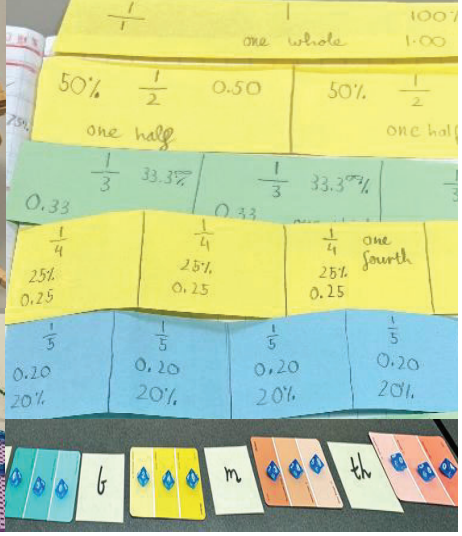


Real-Life Numeracy Years 3-6

Planning Package

Sequential units with hands-on, real-life numeracy for Year 3, Year 4, Year 5 and Year 6 students

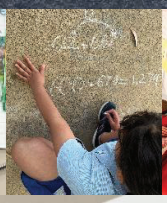
Ten years of development in Australian classrooms.

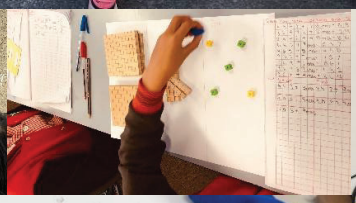
Genuinely high engagement and conceptual understanding in middle to upper primary numeracy.

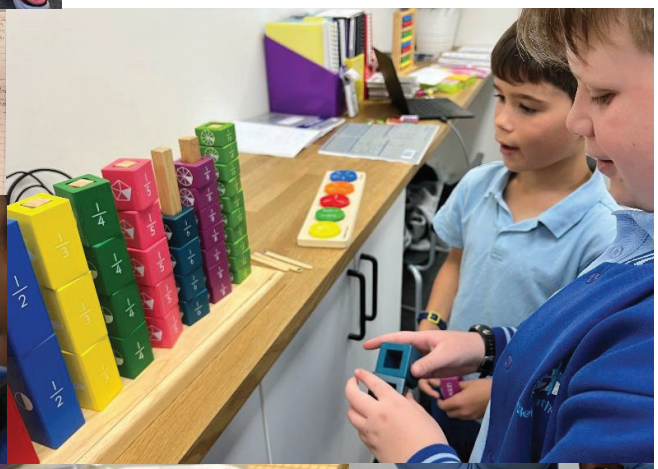
Comprehensive differentiation for wide ranges: Pre-planned and workable enabling and extending prompts for every lesson.

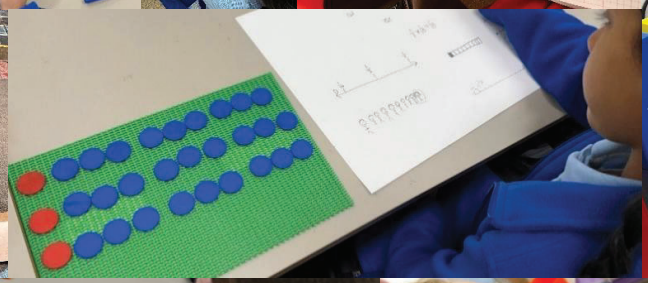
High-impact, high-relevance professional learning on a daily basis to support planning.

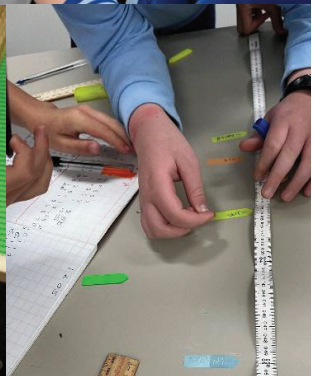
Comprehensive diagnostic and formative assessments to target each sequential point-of-need.











Please note: It is not intended for teachers to attempt to deliver every lesson in this sequence, nor read the unit in full.

Units are designed as **a menu of options**, depending on the points-of-need for each class, with enabling and extending prompts included for every lesson.

Please choose lesson options based on assessed points-of-need (units are directly linked to the assessments), using either Top Ten's or other **strategy-focused diagnostic pre-assessments.** We recommend avoiding multiple-choice/click-the-answer tests, as numeracy as a discipline grows students' reasoning and thinking skills, ability to explain and show strategies, as well as deep conceptual understanding. Answers alone are not the ultimate goal, or a worthy aspiration without student reasoning.

Please also select lessons that best suit students' interests and your own creativity and passion. Units are designed to share the wisdom of practice, while respecting and safeguarding the professional role of the teacher as the ultimate best judge of what students need.

Adjust how many lessons you deliver based on student progress throughout the unit, which can be tracked using the formative assessment folder.

Place Value for Year 5 – 5A Constructing and Recording Hyperlinked Table of Contents

Place Value Unit for Year 5

Curriculum Links for the following lessons

This unit is recommended for Year 5 students.

Laying the place value foundations for content descriptors relating to place-value based strategies for operating on numbers: **Australian Curriculum V9 AC9M5N06 and Victorian Curriculum Version 2.0 (VC2M5N06) – Level 5:** Solve problems involving multiplication of larger numbers by one- or two-digit numbers, choosing efficient mental and written calculation strategies and using digital tools where appropriate; check the reasonableness of answers

- solving multiplication problems such as 253 × 4 using a doubling strategy, for example, 2 × 253 = 506 and 2 × 506 = 1012
- using an array to show **place value partitioning** to solve multiplication, such as 324 × 8, thinking 300 × 8 = 2400, 20 × 8 = 160, 4 × 8 = 32 then adding the parts, 2400 + 160 + 32 = 2592; and connecting the parts of the array to a standard written algorithm

Australian Curriculum V9 AC9M5N08 and Victorian Curriculum Version 2.0 (VC2M5N08)

Number – Level 5: Check and explain the reasonableness of solutions to problems, including financial contexts using estimation strategies appropriate to the context

- interpreting a series of contextual problems to **decide whether an exact answer or an approximate calculation is appropriate**, and **explaining their reasoning in relation to the context and the numbers involved**
- recognising the **effect of rounding** addition, subtraction, multiplication and division calculations, and rounding both numbers up, both numbers down, and one number up and one number down; and explaining which estimation is the best approximation and why
- **considering the type of rounding that is appropriate when estimating** the amount of money required; for example, rounding up or rounding down when buying one item from a store using cash, compared to rounding up the cost of every item when buying groceries to estimate the total cost and not rounding when the financial transactions are digital

Australian Curriculum V9 AC9M5N09 and Victorian Curriculum Version 2.0 (VC2M5N09)

Number – Level 5: Use mathematical modelling to solve practical problems involving additive and multiplicative situations, including simple financial planning contexts; formulate the problems, choosing operations and efficient mental and written calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation

- modelling a series of contextual problems, deciding **whether an exact answer or an approximate calculation is appropriate, and explaining their reasoning in relation to the context and the numbers involved**

New WA Curriculum – Number and Algebra – Understanding Number – Year 5: Read, write and order seven-digit numbers and beyond.

New WA Curriculum – Number and Algebra – Understanding Number – Year 5: Represent and partition numbers up to seven digits. Use the multiplicative place value relationship between adjacent places to explain the value of a digit.

NSW Syllabus – Stage 3 – Represents numbers A

Whole numbers: Recognise, represent and order numbers in the millions

- **Name millions using the place value grouping of ones, tens and hundreds**
- **Arrange numbers in the millions in ascending and descending order using place value**
- Round numbers to a specified place value

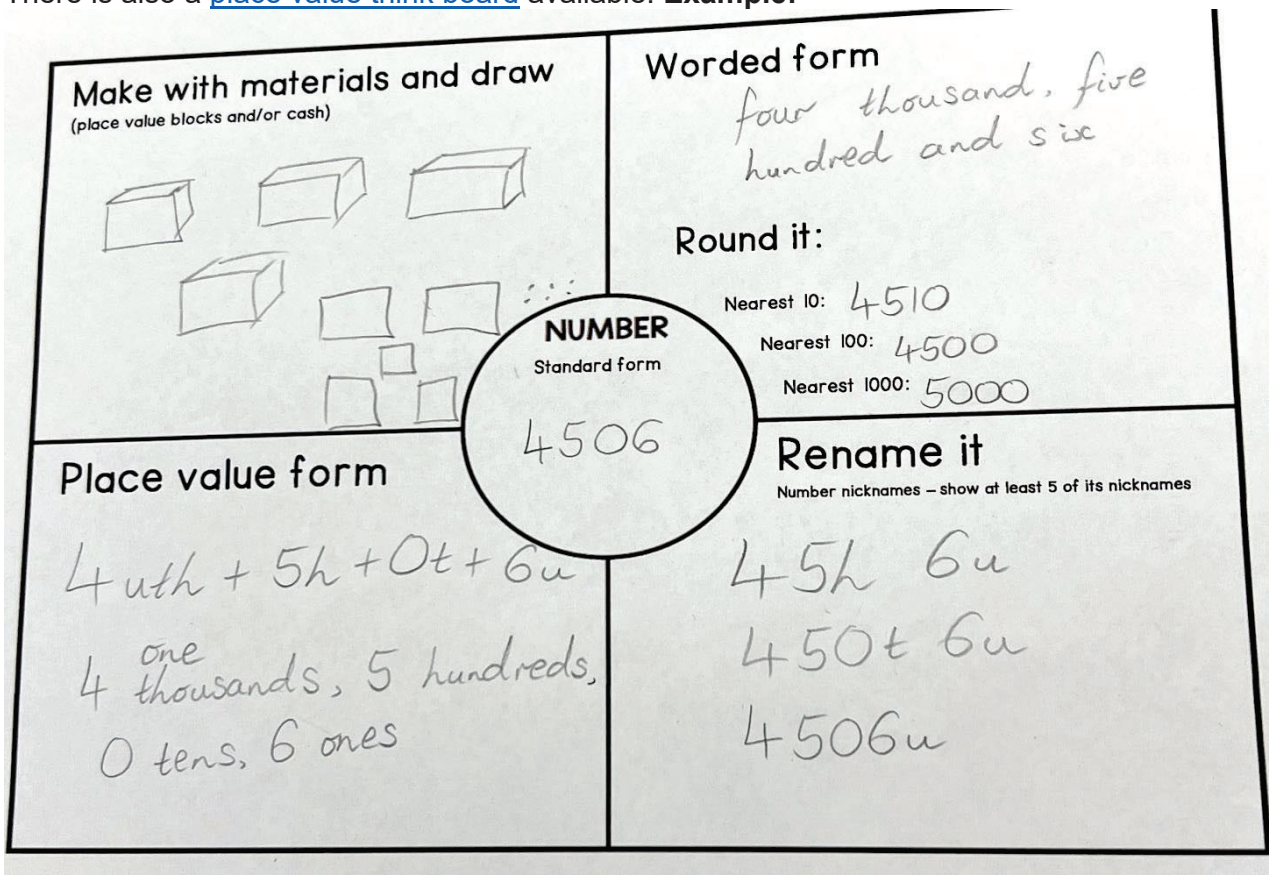
Whole numbers: Apply place value to partition, regroup and rename numbers to 1 billion

- Recognise 1000 thousands is 1 million and 1000 millions is 1 billion
- Regroup numbers in different forms (Reasons about quantity)
- Partition numbers to 1 billion in non-standard forms

Formative Assessment

A formative assessment cross-check is available in this unit's folder with progressive learning goals and specific success criteria for this unit. This includes a grid template or a section template for notes, whichever the teacher prefers to use.

There is also a place value think board available. **Example:**



The ghost of place value past shall haunt you all year...

Rush through place value during Term 1 at your peril – its ghost will haunt you for the rest of the numeracy year. You start split strategy – students cannot partition mentally. You start jump strategy – students cannot jump in multiples of a place value, nor bridge or rename. You start multiplication, students cannot estimate because they cannot round, so produce unreasonable answers. You try division – they cannot partition or rename. It is worth the seven weeks.

Teaching Tips

Developmental sequence: There is a recognised sequence for teaching any new phase of place value.

1. Introduce the new unit: 10 of these = 1 of those, or 100 of these = 1 of those, or 1000 of these = 1 of those. In year 4, this extends to 10 000 ones = 1 ten thousand. In year 5 this extends again to 100 000 of these is 1 of those.

2. Deal with language problems (tens; teens; *and* after hundreds; repetition of the h-t-o pattern in second phase place value; saying the name of the place value family – "*thousands"* at each interval of 3 digits).

3. Make, model and name regular examples (354 643, 735 783).

4. Irregular examples (teens 517 214, internal zeroes 760 703).

5. Round to any place value (round 524 784 to the nearest ten, hundred, one thousand, ten thousand and hundred thousand.

6. Rename and partition 6-digit numbers flexibly (524 784 as 52 ten thousands 47 hundreds 84 ones, or 524 thousand + 784 ones, or 250 000 + 250 000 + 24 784).

7. Abbreviated or alternative ways of writing larger numbers, such as abbreviated forms (350 000 as 350k), and scientific notation (350 000 as 3.5×10^5).

The unit follows this sequence, by first introducing the hundreds of thousands and beyond, including the big idea of 10 ten thousands = 1 hundred thousand, or 100 one thousands, or 1000 hundreds, or 10 000 tens, or 100 000 ones, focusing on recording using place value form, standard form and worded form.

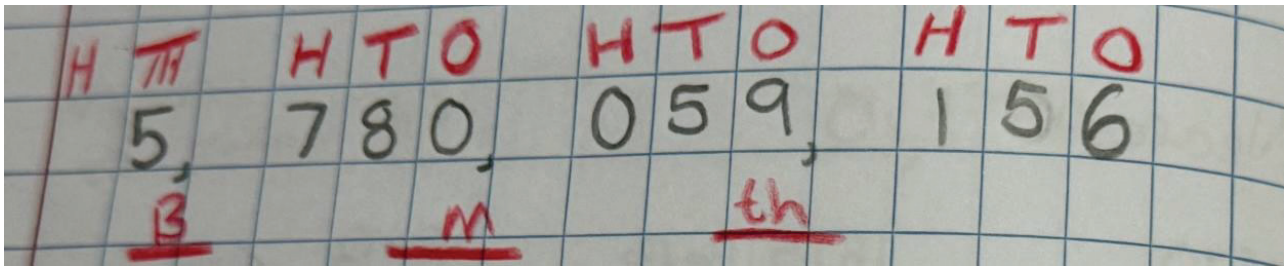
Then the unit recommends lessons relating to rounding, renaming, adding/subtracting place values, and flexibly partitioning these numbers to operate from other parts of the place value folder.

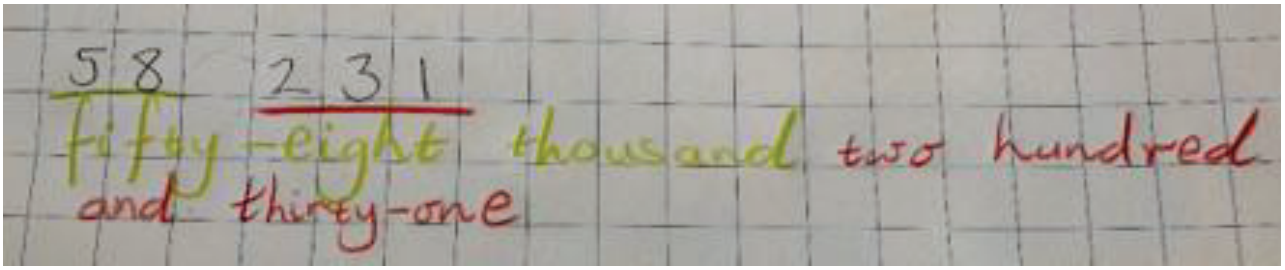
Paint Samples Place Values – If you can read 3-digit numbers, you can already read massive numbers!

Critical tip for reading and writing larger numbers in words

Place value paint samples

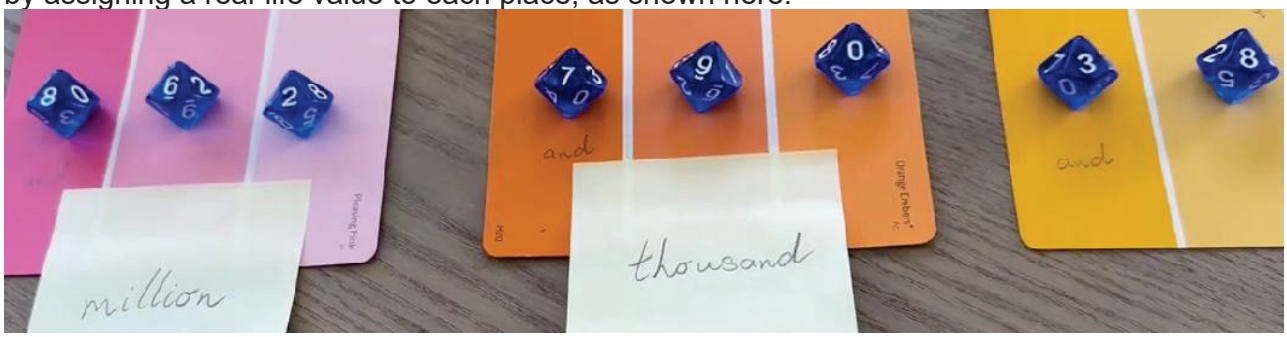
https://youtu.be/eadZHFYVshU?si=gkjq-6bcun1a6hZ0





Real-life connections

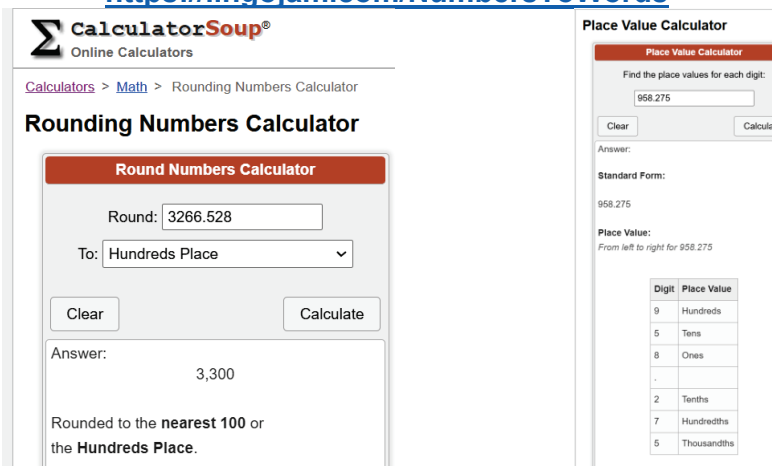
The strategy for saying and writing larger numbers in words can become even more meaningful by assigning a real-life value to each place, as shown here:



https://www.youtube.com/watch?v=Uk554fOB7XU

Immediate feedback mechanisms

https://lingojam.com/NumbersToWords



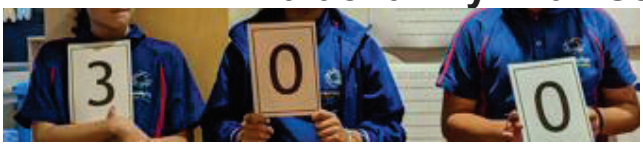
https://www.calculatorsoup.com/calculators/math/roundingnumbers.php

https://www.calculatorsoup.com/calculators/math/place-value-calculator.php

Place Value Families of Students (Groups of 3)
'Become the Number'

With great thanks to Mernda Park PS

Read each set of 3 numbers, then all three students say the place value family in unison:

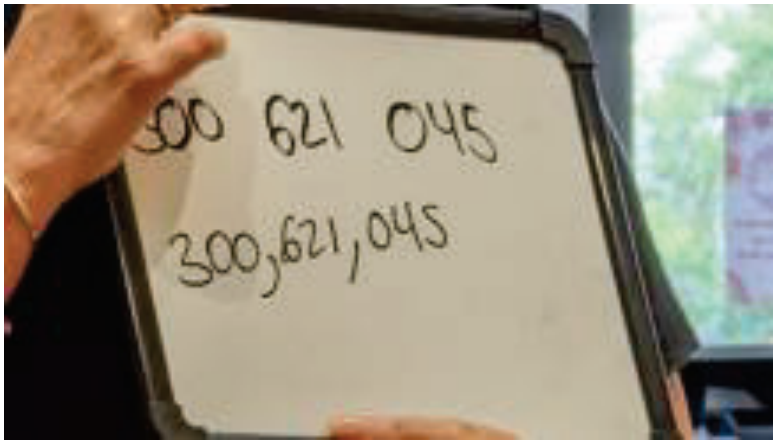


"300 MILLION!"

"621 THOUSAND!"

"AND" 

45 (No family is said for the final place value, as we don't say 'ones' when reading a number – it is assumed the final place is ones).

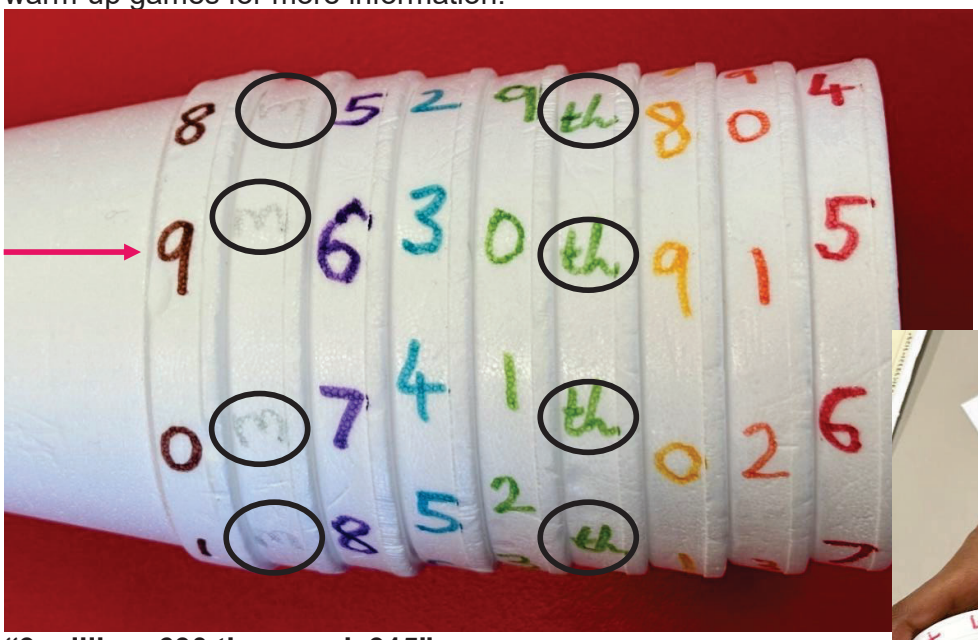


Spaces and commas were modelled, as both are seen in real-life contexts.

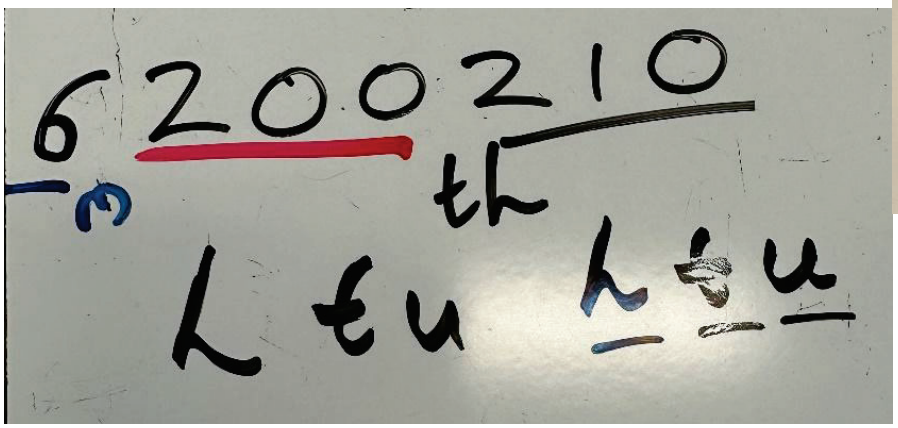
Even though the official Australian convention is to use spaces, commas are regularly encountered in real-life contexts, so it is best practice to model both.

Place Value Cups

An excellent resource to support reading large place values – see the *Year 6A Place Value Unit* warm-up games for more information.

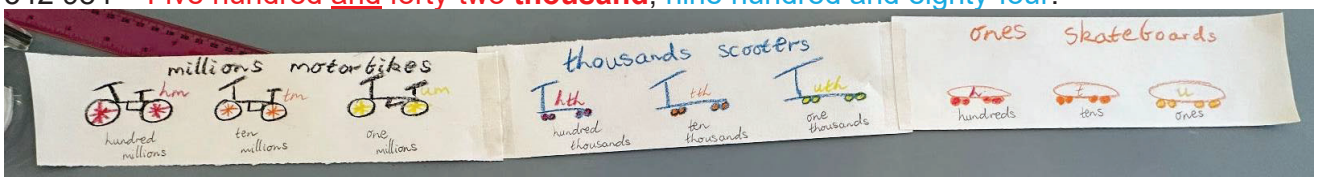


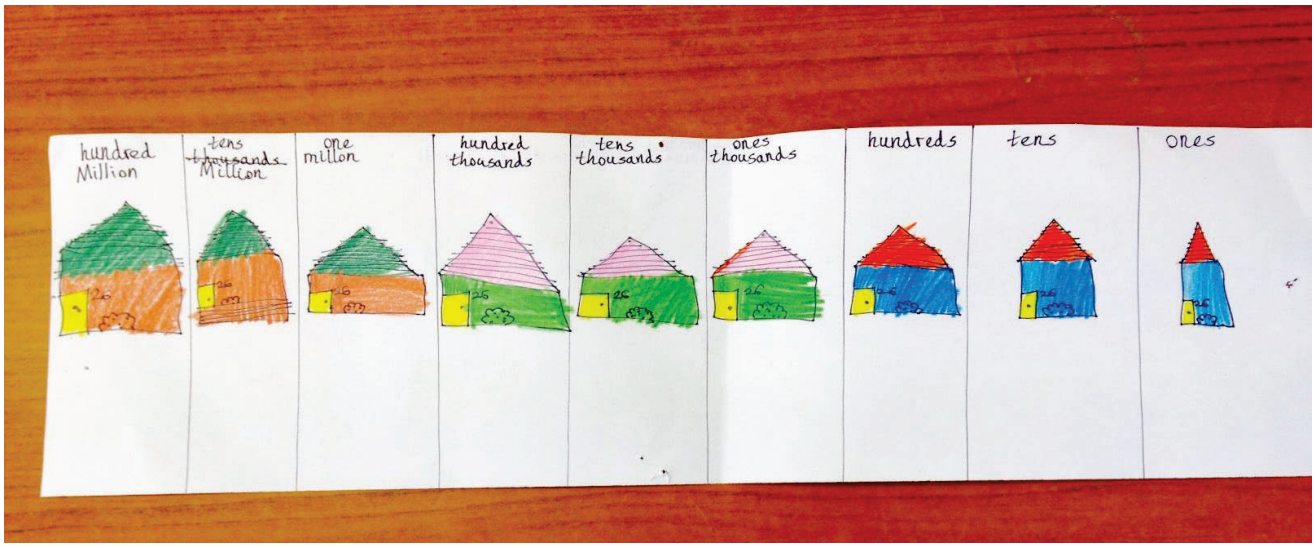
“9 million, 630 thousand, 915”
Once you know how to read 3-digit numbers, you can read so much more!



Underline three places at a time starting from the right.

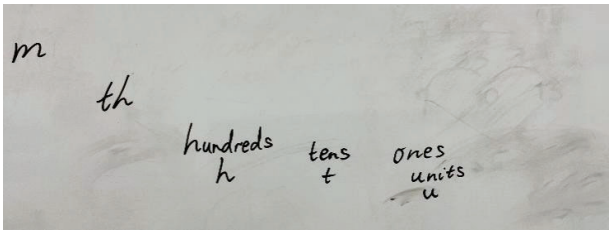
Second phase place value: As students progress to working with thousands and tens of thousands, it is critical to introduce the place value pattern that recurs throughout our base-ten system (hundreds, tens and ones). Students who have not had this pattern highlighted to them and reinforced often believe that the place value system is as such, “ones, tens, hundreds, thousands, millions, billions.” Representations that highlight the ‘three in each place value family’ understanding, and the repetition of the hundreds, tens, ones pattern within each, are ideal to combat this misconception. This then becomes a very efficient strategy for students to accurately say, read and write very large numbers in worded form, by focusing on three places at a time, saying the number as if it were just a hundreds number, then saying the place value: 542 984 = Five hundred and forty-two **thousand**, nine hundred and eighty-four.

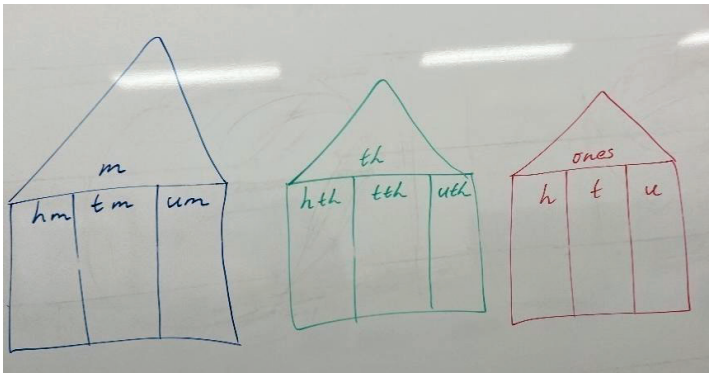




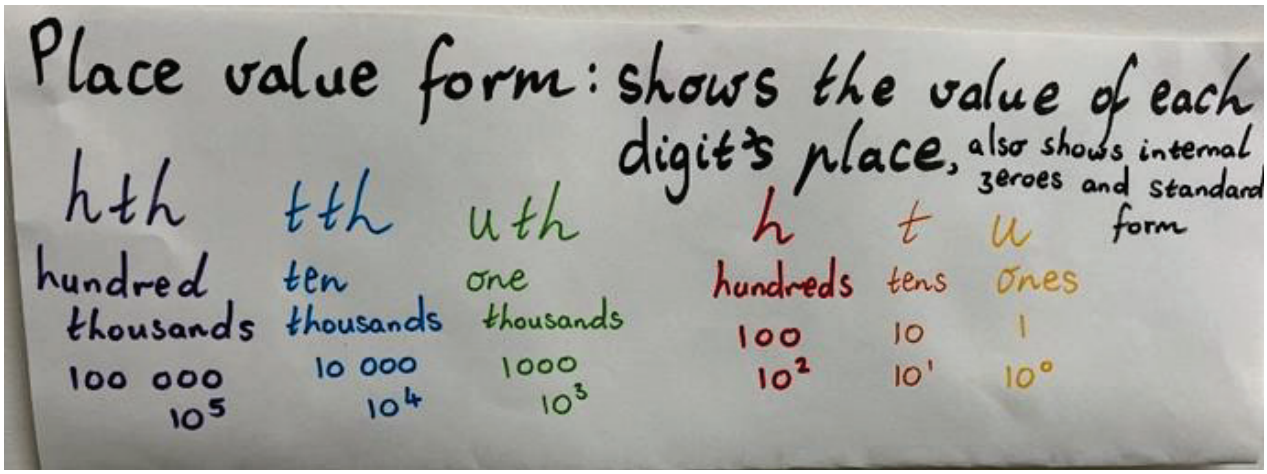
Students’ common misconception – That place values work as ones, tens, hundreds, thousands, millions

Place value patterns – ones, tens, hundreds exist in all place values in sets of 3, so it is, in fact, ones, tens, hundreds; ones, tens, hundreds of thousands; ones, …





Anchor chart examples



Changing the language of 'MAB' to place value blocks

While the commercial name for the most commonly used materials throughout this unit is 'MAB,' it is critical to instead call these 'place value blocks' for our purposes in the classroom, to reflect why and how we are using the materials. MAB is abstract language that does not form part of long-term maths vocabulary, compared to 'place value.'

Comparing numbers

Once materials are in use, students generally learn how to compare and order numbers reasonably quickly. This often does not represent a significantly challenging gap to address – it tends to fall into place naturally alongside tasks that relate to constructing, recording, rounding and renaming numbers. However, if difficulties present, these strategies may be of benefit.

Cash connection: As in, “Would you like 5 thousand 4 hundred and thirty-two dollars, *or* 4 thousand 5 hundred and twenty-three dollars?”

Using place value blocks to compare: Students build place values as towers, seeing that the values change the size of the number considerably, depending on which digit is in which place value position. It is not sufficient to use playing cards alone – use the blocks, like so:

2 162 4321 5433 7015 9424

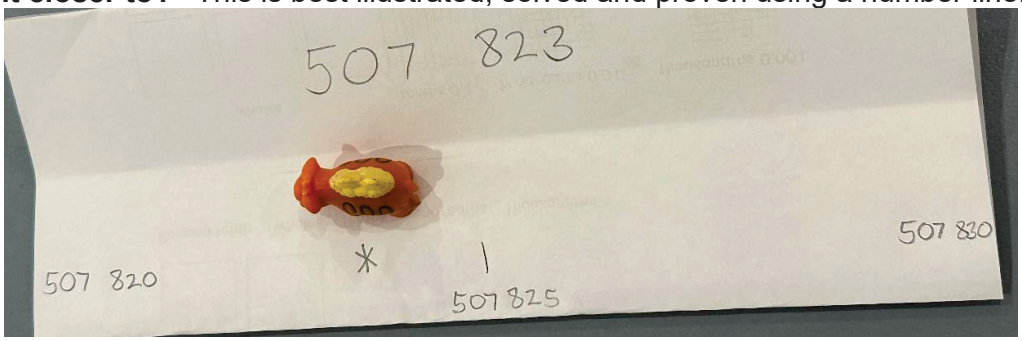
The blocks can visually show how a different digit in that place value position drastically alters the size of the number (playing card tasks without blocks do not achieve this).

Using number lines to compare: It is also valuable to challenge students to place numbers along a number line (use the same set of digits, change which places the cards are within, and mark each number along a number line to prove their order).

As our place value system is ‘left-leading’ and base-10, this means that any place to the left is worth 10 times more than one place further to the right and, thus, ‘Left rules, right drools by a factor of 10 or by x10’ – but students must understand why, rather than applying this ‘rule’ without concrete or visual understanding.

Rounding

Avoid ‘rounding rollercoasters’ or ‘rounding mountains.’ Instead, repeat this critical question: **“What is it closer to?”** This is best illustrated, solved and proven using a number line.



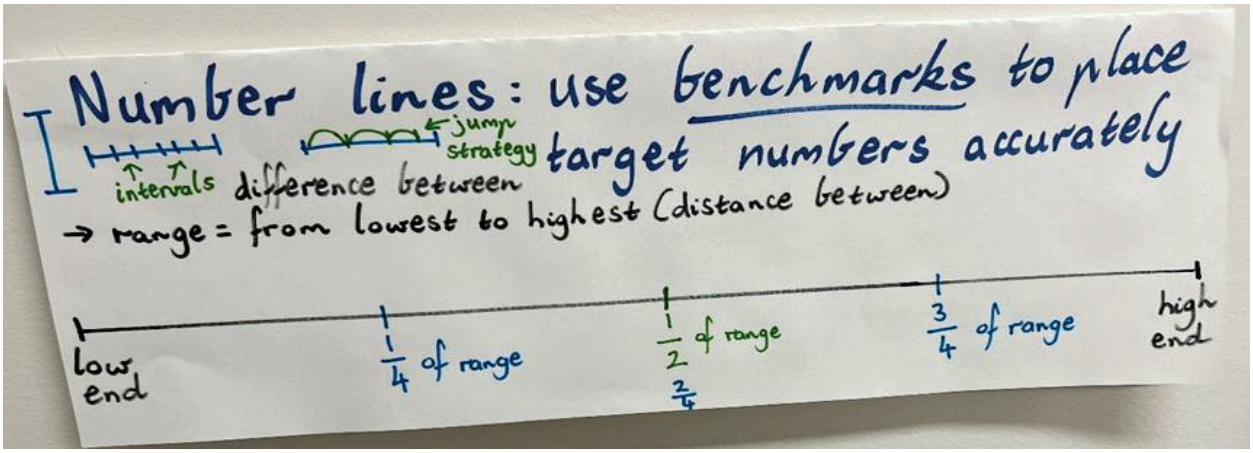
Rote rules relating to underlining the place next door, and so on, often falter in students’ memories when they are conceptually challenged, and also do not create genuine number sense in terms of number line awareness. These fragile procedures frequently fall to pieces when students are asked to round inside a place value (rounding a tens of thousands number to the nearest ten), or estimate while operating, as the rules are too fragile to be applied meaningfully and with a number sense that is critical for real-life numeracy.

Research quoted in Clarke et al (2008): **According to this large-scale study, if we do not teach or emphasise rounding and estimation throughout the year of numeracy, we are setting students up to fail in more than 60 percent of real-life scenarios.**

> Surveys completed by two hundred adults over a twenty-four-hour period found that more than 60 percent of all calculations carried out in daily life only required an estimate (Northcote and McIntosh 1999). We believe that the curriculum emphasis should reflect this finding. This is one reason why teaching fraction algorithms for the four operations does not prepare students for real-life encounters with fractions, where mental estimation is the key skill.

The discussion point then becomes the ‘5,’ as it lies in the centre of the number line, so does not appear to be visually closer to either side. There is a reason 5 rounds up – what do you think? (Take some thinking time before reading on…).

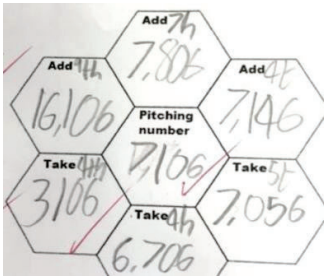
The reason that 5 rounds up is not simply by rule/convention – there is a mathematical basis for it. How many digits are there? There are 10 digits, including zero. So if we count on one hand – 5 digits go down, and 5 go up. That is an even or fair share for situations in life when we round down, and others when we round up.



Renaming, when used to its highest effect, is not concerned with preparing students for the vertical algorithms at all – that is a slightly positive after-effect.

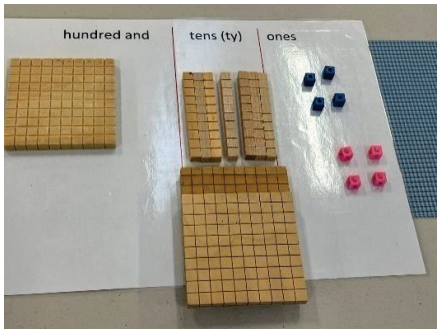
Renaming is about **building flexibility with number sense** that can be used to great effect for mental strategies that are to follow throughout the year for every operation.

For example, if a student needs to work out 7106 – 400, a student who can rename would be aware that within 7106 there are 71 hundreds. 71 hundreds – 4 hundreds = 67 hundreds, making the answer 6706 (since the tens and ones do not change when taking away a multiple of 100).



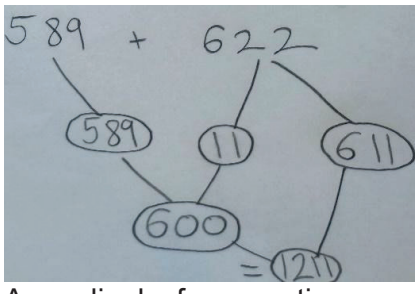
Renaming is similar to giving a number its **Aussie nicknames**. Like many Aussies, numbers have lots of nicknames!

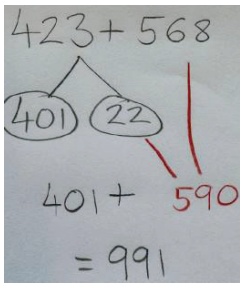
In the early years, students were trained to use superhero eyes (subitising). Now their eyes are upgraded to 'x-ray eyes' that can slice larger place value blocks into their base-ten parts. The best way to do this is to set up a number in its regular sense on a place value chart, then physically push blocks to the right, renaming (with x-ray eyes) those values in that place value.

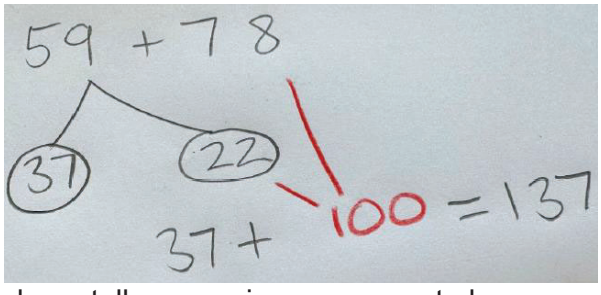


Flexible (non-standard) partitioning

It is also important to show students that they can partition in a non-standard/flexible format as well. For example, for these addition problems, it would potentially be quite an efficient strategy for some students to engage in the following examples of flexible (non-standard) partitioning, renaming one part (partitioning/breaking it another way, that is not a pure place value split):







Accordingly, for operating on numbers efficiently and mentally, renaming can prove to be an extremely valuable tool.

Materials Organisation – PowerPoint summary and video link showing schools' organisational methods

Place value blocks organisation: To reduce pack-up and set-up times, it is critical to organise an efficient strategy for the distribution of place value blocks to each pair of students. In our experience, these are a few strategies that work best:

Transparent containers with at least 1 thousand cube, 12 hundreds, 12 tens and 12 ones, or open trays with more than sufficient supplies:

Left-hand image: Students at Herberton State School are allocated a container with a place value block set (1 thousand, 12 hundreds, 12 tens, 12 ones), as well as all the essentials for that week's lessons (templates for the week, dice, cash notes, and so on).
Right-hand image: Chirnside Park PS uses a barbeque tray style method.

Tupperware from Woolworths/Coles:

Fits precisely 20 tens, as well as 20 ones and all dice.

Thousand block and 12 hundreds.

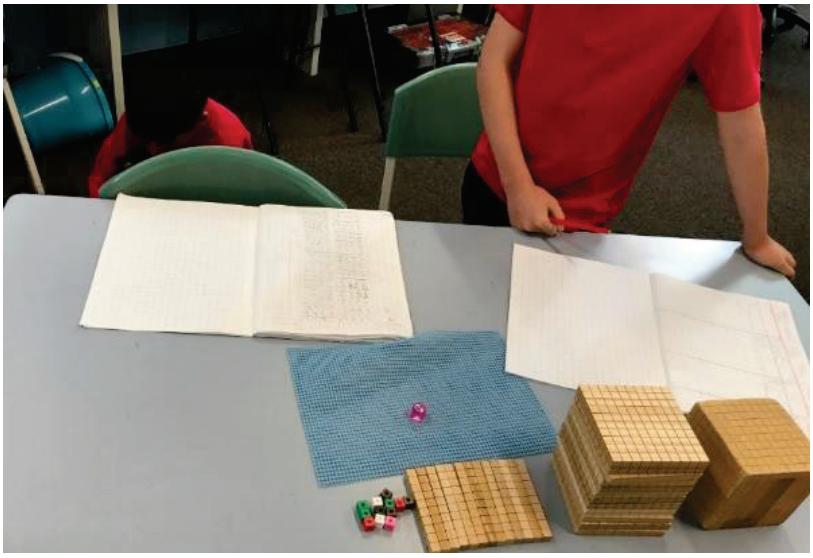
Grab-and-go partner container sets for Year 3/4 (20 hundreds, 20 tens, 20 ones, and as many thousands as possible in partner sets).

Cotton bags with 1 thousand, 12 hundreds, 12 tens and 12 ones. More thousand blocks available in the corners of the room.

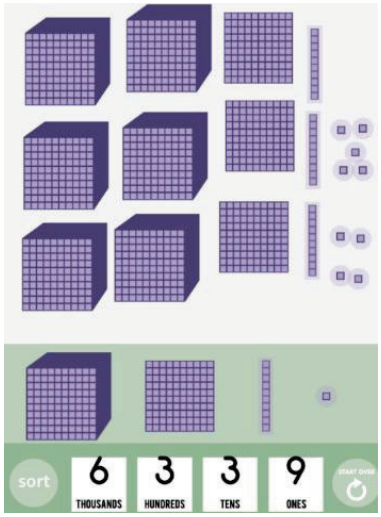
Top Ten member schools' exceptional organisation systems, with place value blocks set up, ready to collect and pack up in 1-minute flat: **video link**.

As the materials take up a significant amount of space on desks, it is also important to 'clear the desks' prior to each lesson, removing pencil cases, novels, water bottles and any other items, as shown here.

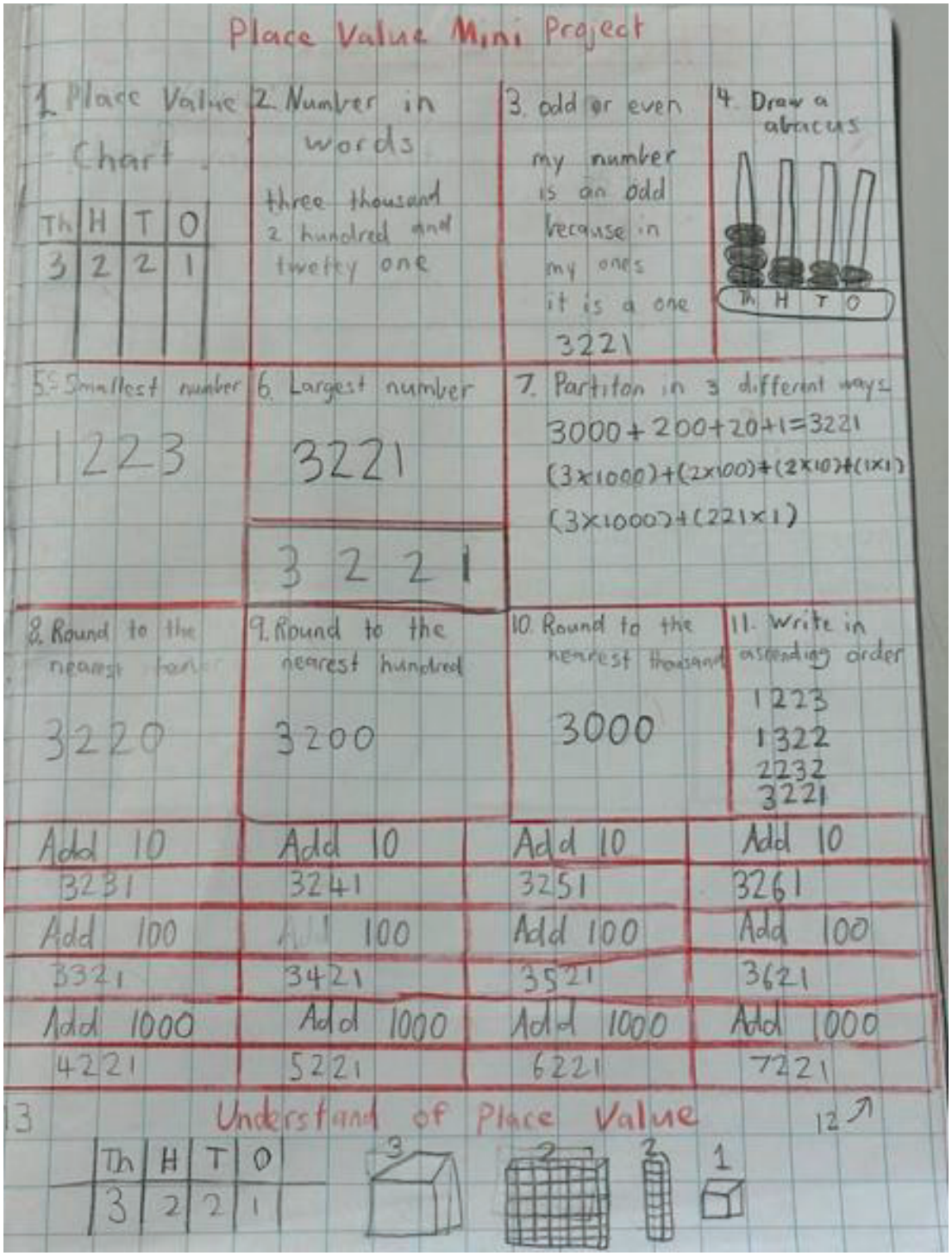
It is important to access sufficient place value blocks for students to create representations of 4-digit numbers and see the sheer size difference between the thousands, hundreds, tens and ones, as well as the difference between, for example, 2404 and 4204.



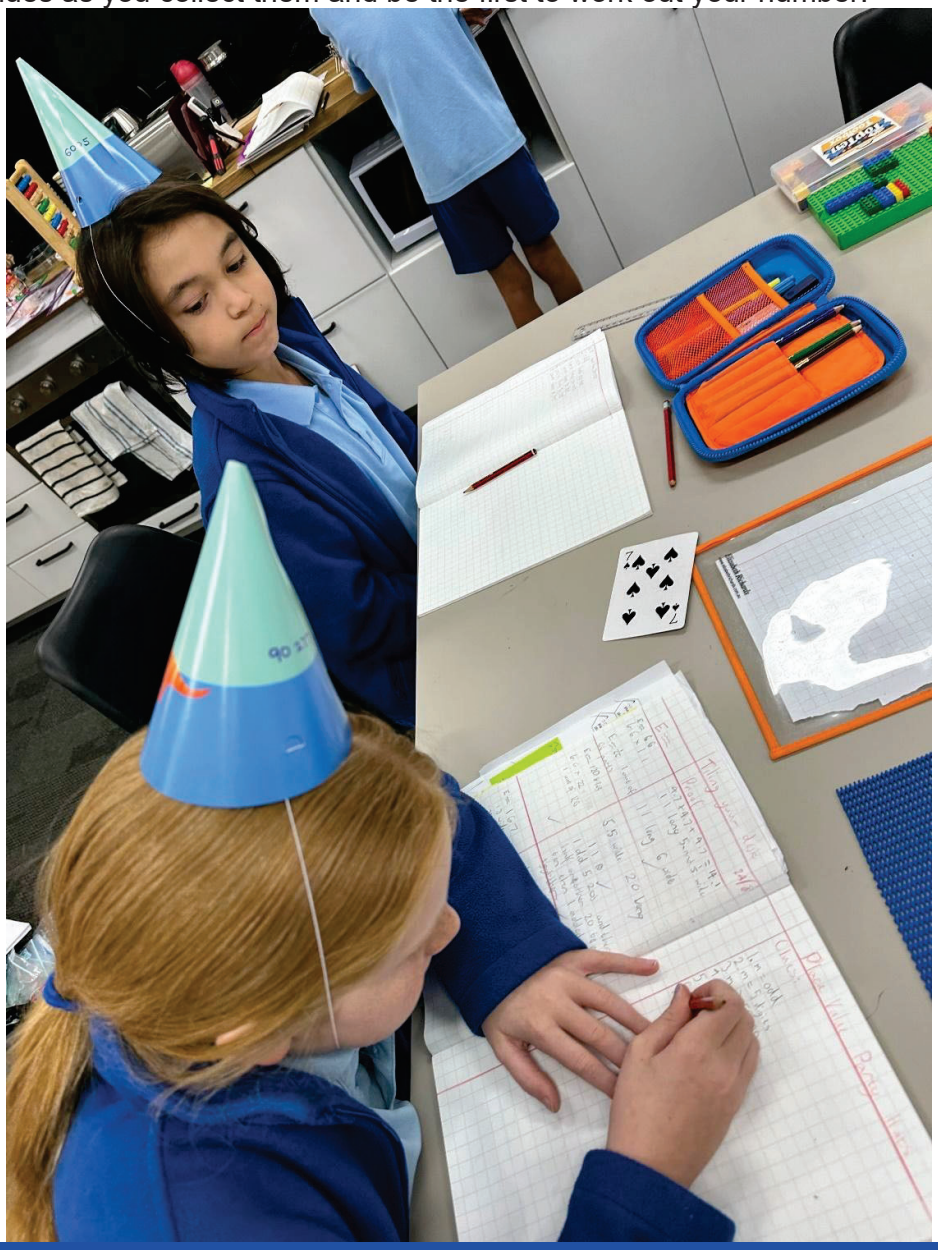
However, the reality is that some classrooms are under-resourced. For those classrooms, there is an ICT alternative, which is significantly less effective than physical representations and hands-on learning experiences, but is preferable to a worksheet: https://www.abcya.com/games/base_ten

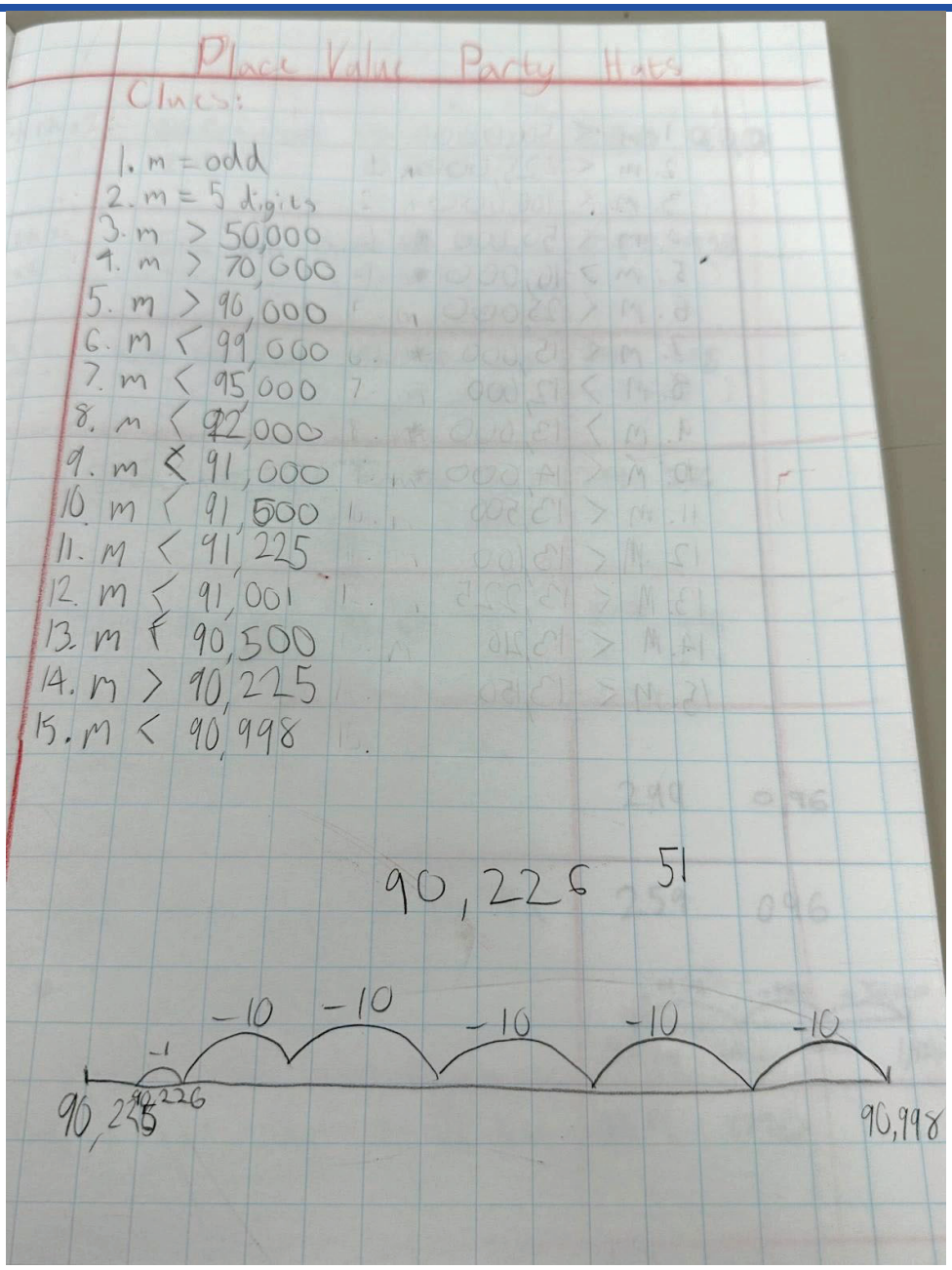


Student Maths Glossary and Reflection Journals – Unit launch glossary and activating prior knowledge brainstorms co-constructed with the teacher

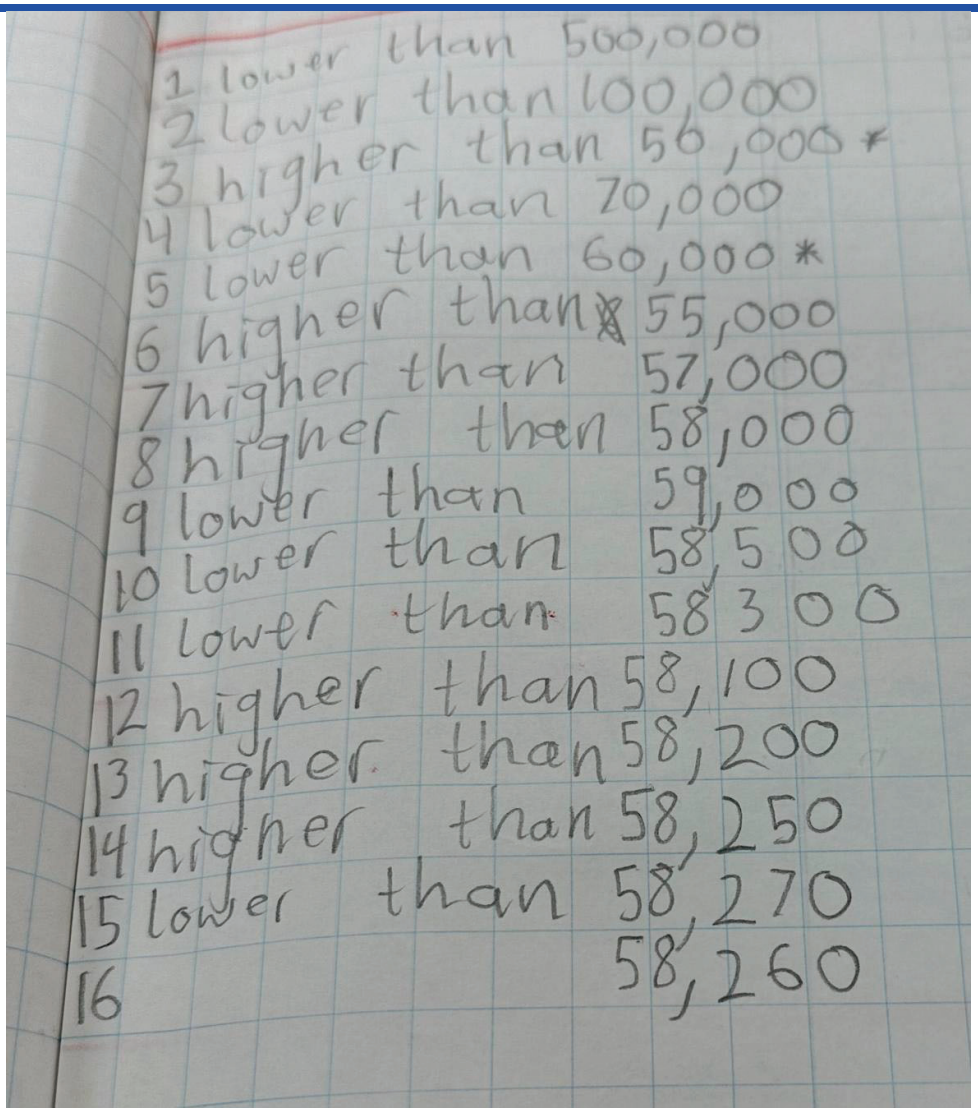


Warm-up Games

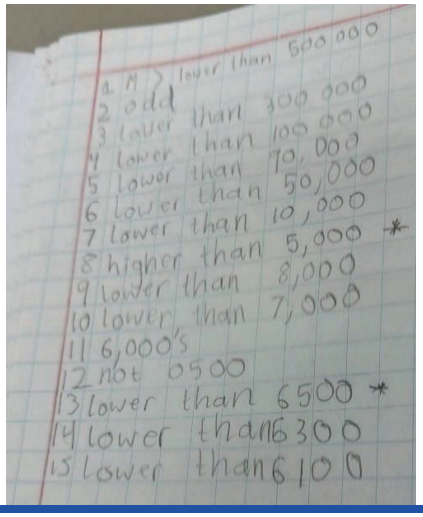
Warm-ups	Second phase place value
Party Hats Place Value and Place Value Battleship	The teacher has written on some 'place value' party hats (e.g. 150 620, see photo below). A partner collects a hat and places it on your head, so you do not see its value. Aim to solve the number on your hat before your partner solves theirs. Take turns to ask questions. Write down the clues as you collect them and be the first to work out your number! 



Place value party hats recording: Student work sample where the numbers on the left-hand side were keeping track of how many questions they had asked and 'm' represented 'mystery number.'



Place value party hats recording:
Student work sample of clues, where the numbers on the far left-hand side were to keep track of their number of questions as students were aiming to solve it in 15 questions or less.



Place Value Shuffle

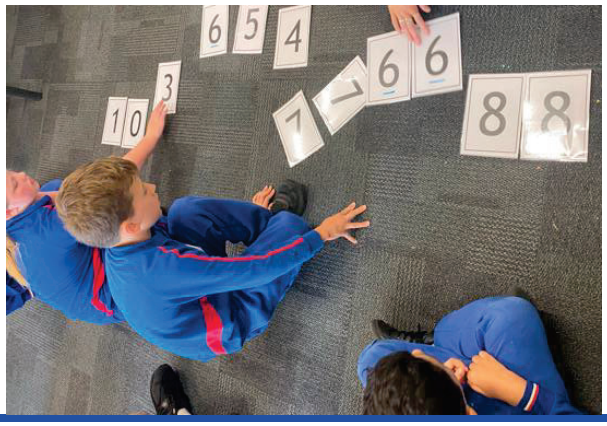
Focus: The place value pattern of 3 (H-T-O), ordering numbers, recording in standard, worded and place value form.

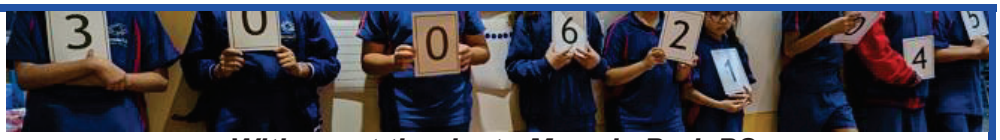
"Six hundred and sixty-nine **million**, eight hundred and fifty **thousand**, nine hundred and eighty-six."

Students line up with number cards, as shown below, standing in groups of 3:

- Make the largest and smallest number possible (use a 'left rules, right drools' rhyme to emphasise the value of the left in our place value system).
- Make all the number combinations that are possible and record these in ascending or descending order. ***Language tip:*** Ascending means 'a small one first,' whereas descending means 'de biggest' first!
- Make the highest odd number possible, or lowest even number.
- What place value is Mila standing in? e.g. 4 hundreds. What if she switches places with Kai?
- Make a number in standard form, then record it in worded form and place value form (9um + 8hth + 5tth + 0uth + 9h + 8t + 6u). *Note:* Here 'tth' stands for 'ten thousands' and 'uth' stands for one thousands, avoiding using 'o' due to potential confusion with zero.

  For worded form, make sure students leave a space between each group of 3, emphasising the hundreds, tens and ones recurring pattern for each place value. "Look at each family of three, say it as if it were just a hundreds number, then say the name of the family ("thousands!") after that.





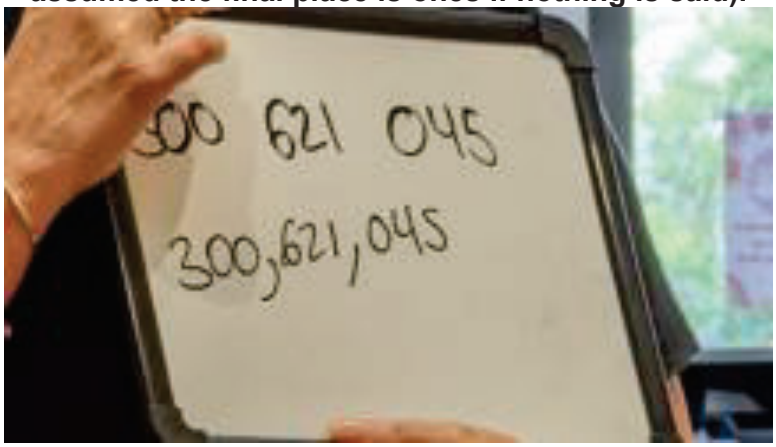
With great thanks to Mernda Park PS

Read each set of 3 numbers, then all three students say the place value family in unison:

"MILLION!"

"THOUSAND!"

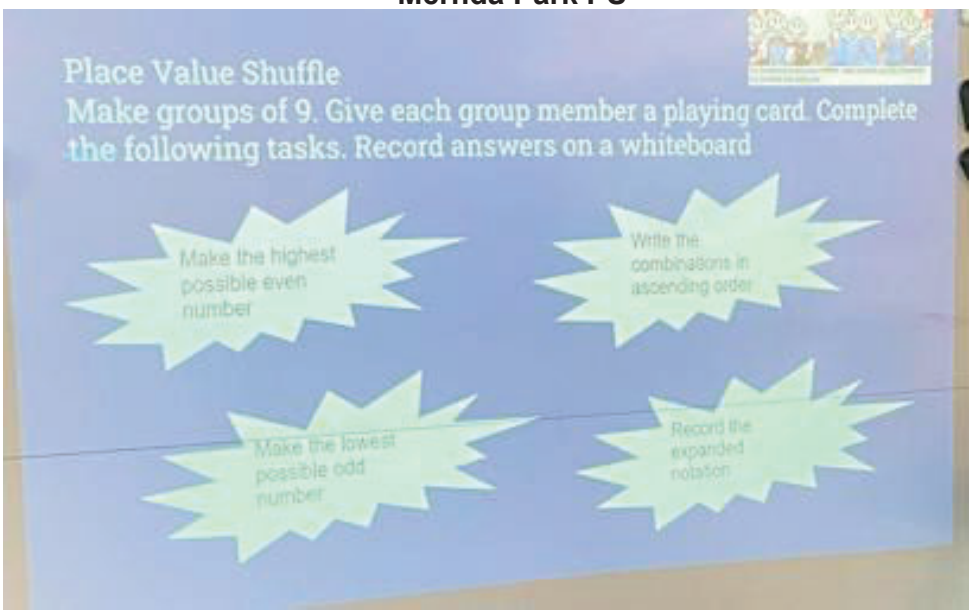
"AND" **(No family said for the final place value, as we don't say 'ones' when reading a number as it is assumed the final place is ones if nothing is said).**



Spaces and commas modelled

Even though the official Australian convention is to use spaces, commas are regularly encountered in real-life contexts, so it is best practice to model both.

Mernda Park PS

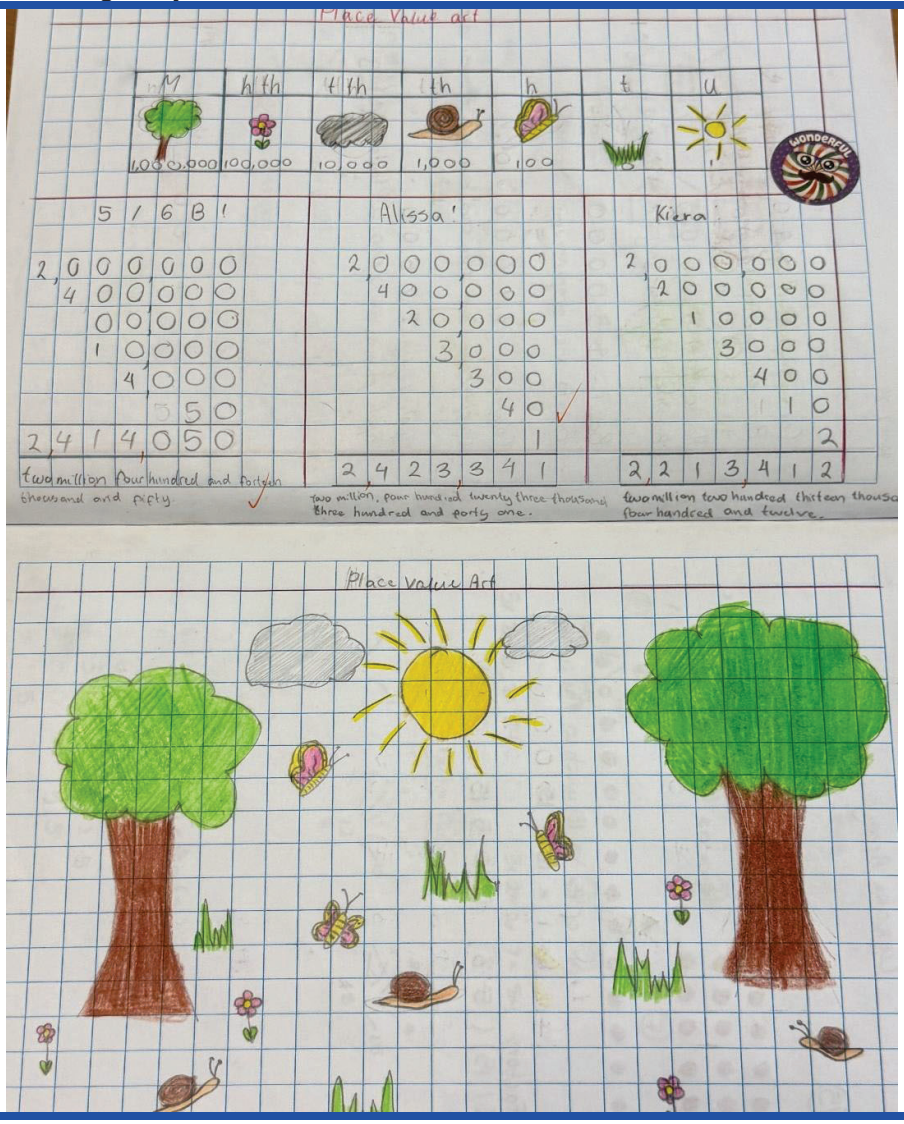


Support: Work in a group of 4, focusing on numbers up to the 9999.

Extension 1: Round each number to a set place value throughout the game, for example, round to the nearest thousand for every number created.

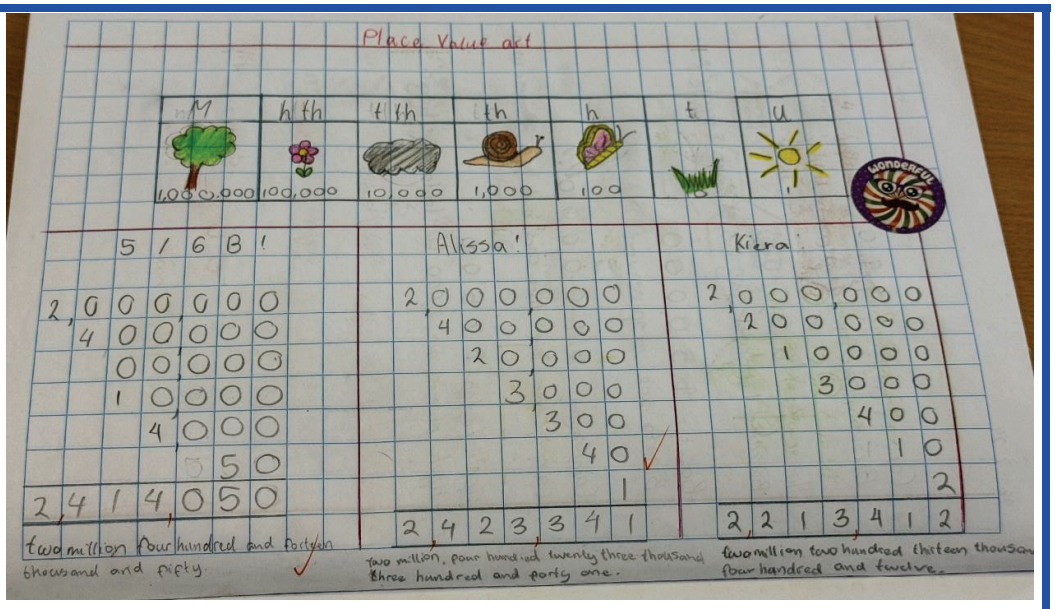
Extension 2: Add a ball as a decimal point in their group. Move the ball around, recording the new decimal numbers this creates, and ordering these against the previous numbers. Also record the decimals using their place value form, like so:

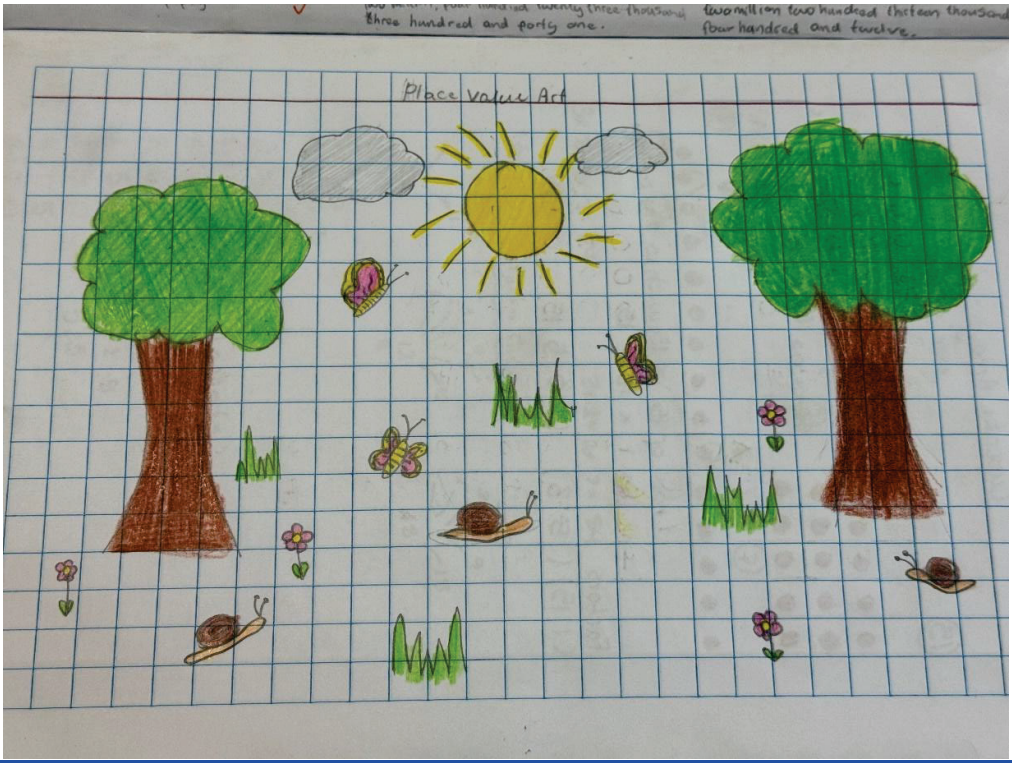
$$5\text{tth} + 6\text{uth} + 4\text{h} + 5\text{t} + 7\text{u} + \frac{8}{10} + \frac{9}{100} + \frac{3}{1000}$$

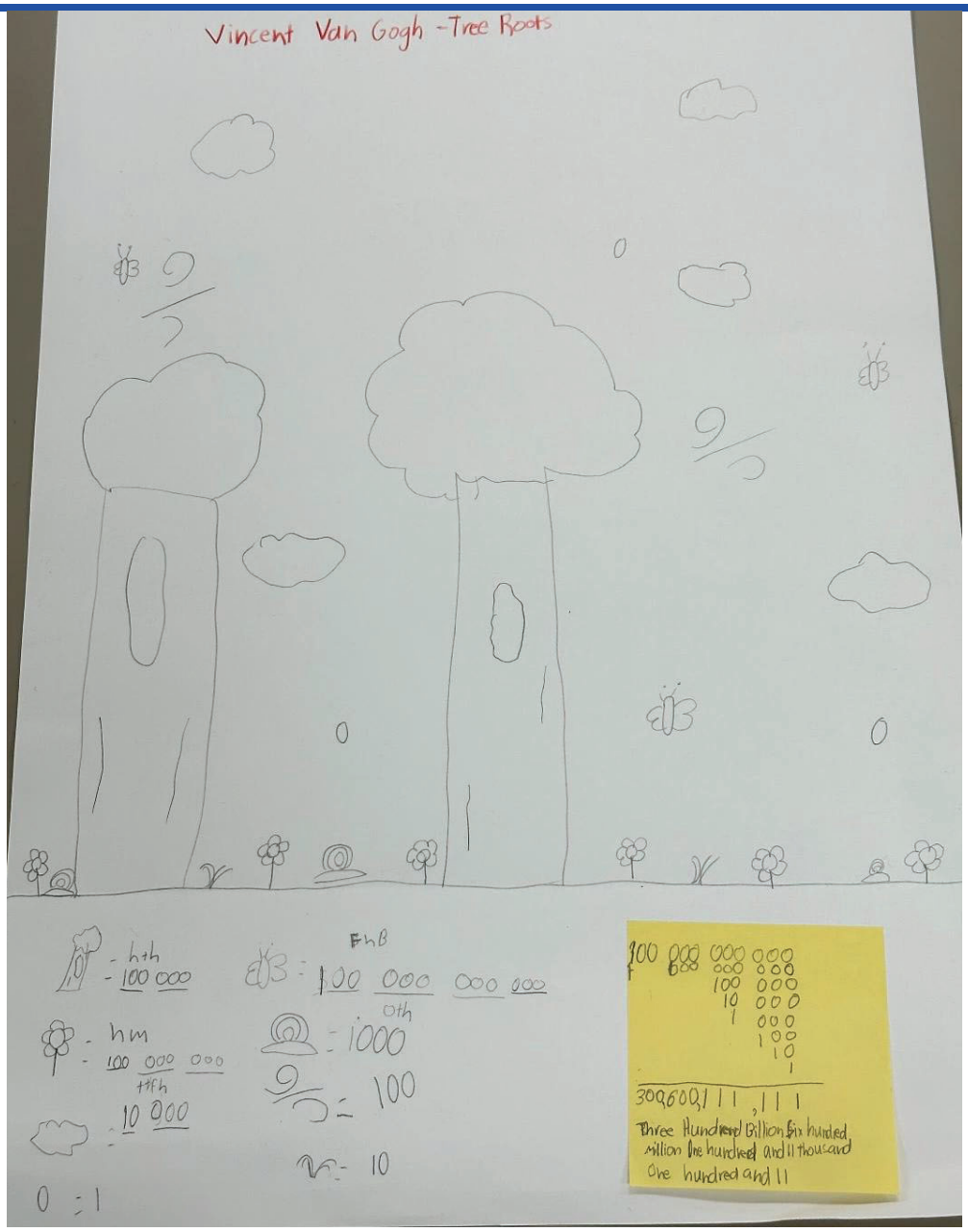
Place Value Year 5A Lesson 5	**Place Value Art** **Learning intention: Show large numbers in abstract ways, converting these to standard form (digits), worded form (words) and place value form (hth tth uth h t u)** **Maths vocabulary: standard form, worded form, place value form**
Artist study – Vincent Van Goh: Students used these images as inspiration for their own place value works of art – link. **YouTube hook:** Take a virtual tour of one of these prestigious galleries: The Wonder of Nature exhibition at the Natural History Museum in London https://artsandculture.google.com/story/take-a-virtual-stroll-through-the-exhibition/CwIC5WiUgJ_VJw or the Vatican Museum in Rome http://www.museivaticani.va/content/mu	**Lesson summary: First, students create place value art galleries using a consistent whole-class key (a particular symbol represents a place value) . Second, students roam the room to solve the values of other students' pieces of art.** **Materials:** • A3 paper. **Best set-up:** Fishbowl model your own example of a gallery. Students create their gallery, then roam to solve and record one another's. 

seivaticani/en/collezioni/musei/tour-virtuali-elenco.1.html or the Guggenheim in Spain https://artsandculture.google.com/partner/guggenheim-bilbao

There is a full list of galleries that offer virtual tours at https://www.theguardian.com/travel/2020/mar/23/10-of-the-worlds-best-virtual-museum-and-art-gallery-tours

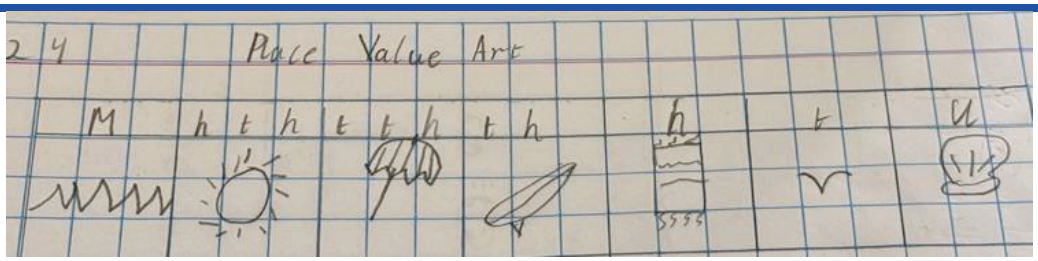




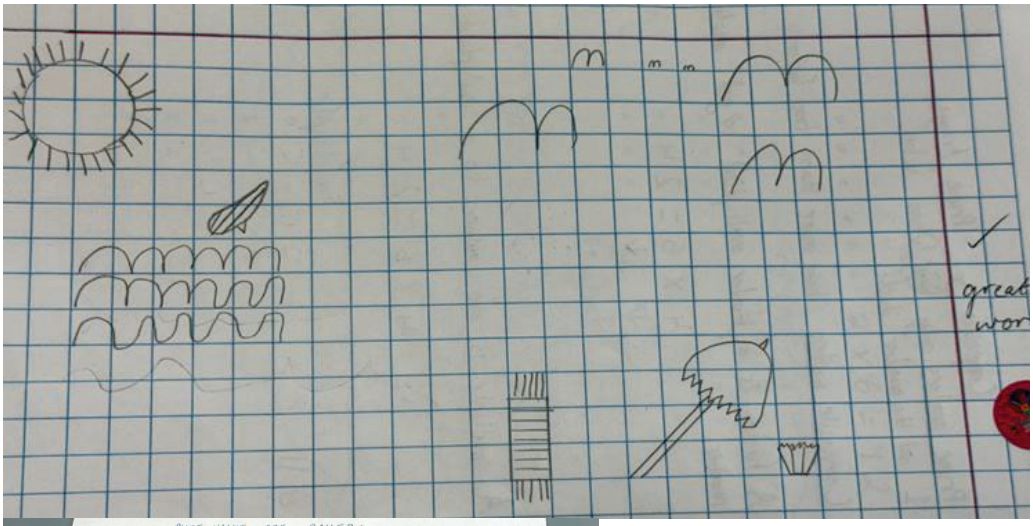


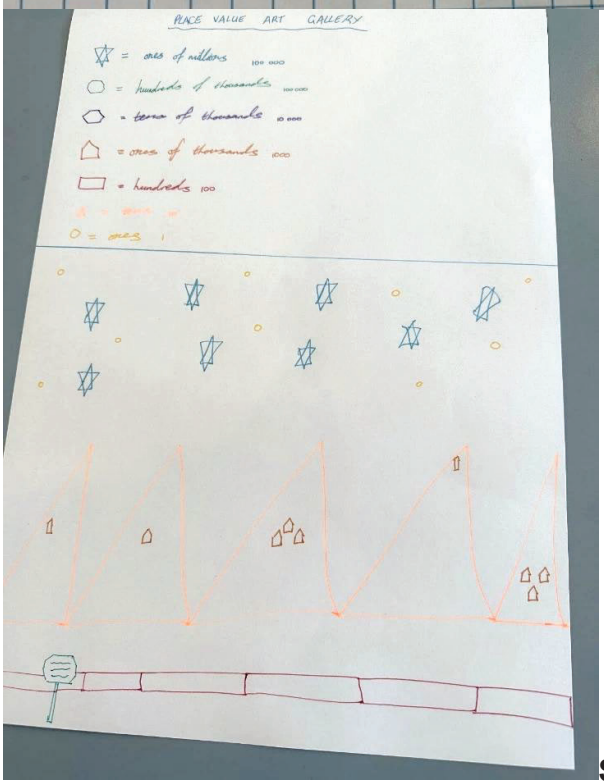
Student work sample based on the Van Gogh hook

Modelling: Model your own example. Provide students with a set time limit to create their place value artwork based on the consistent class key (5-10 minutes at most).

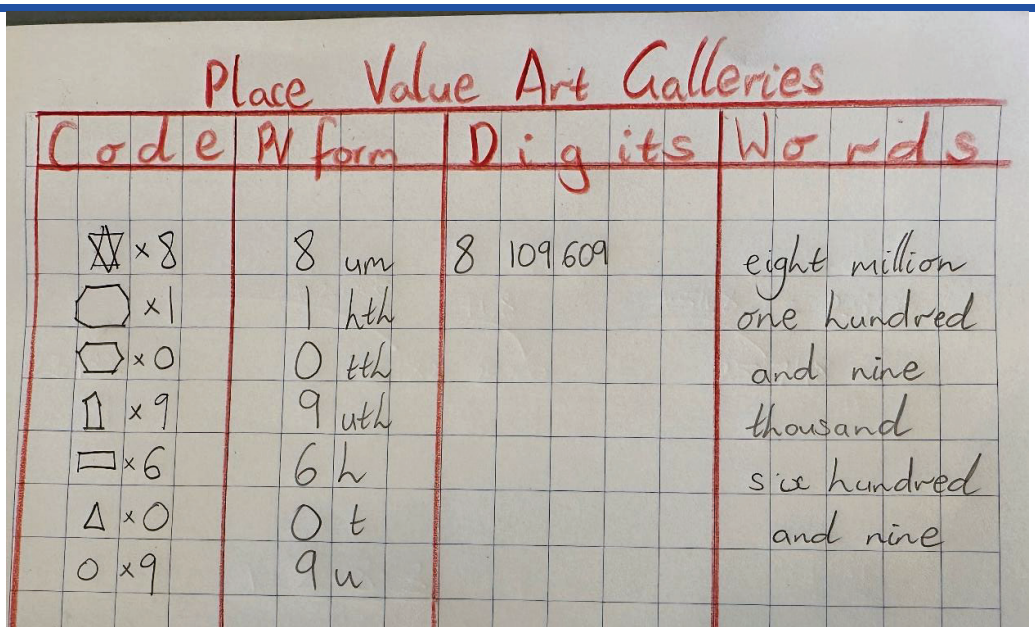


Beach-themed key/legend and matching place value artwork for classmates to solve below:

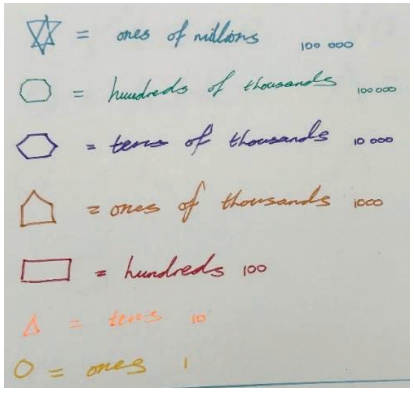




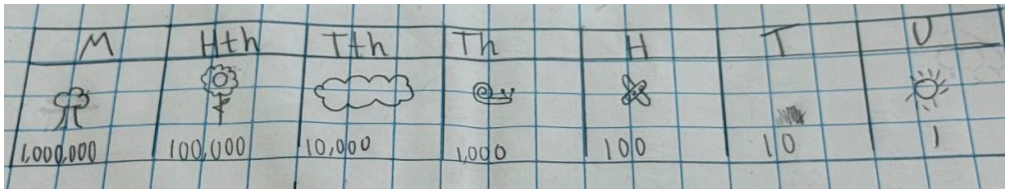
Starry night by Van Gogh



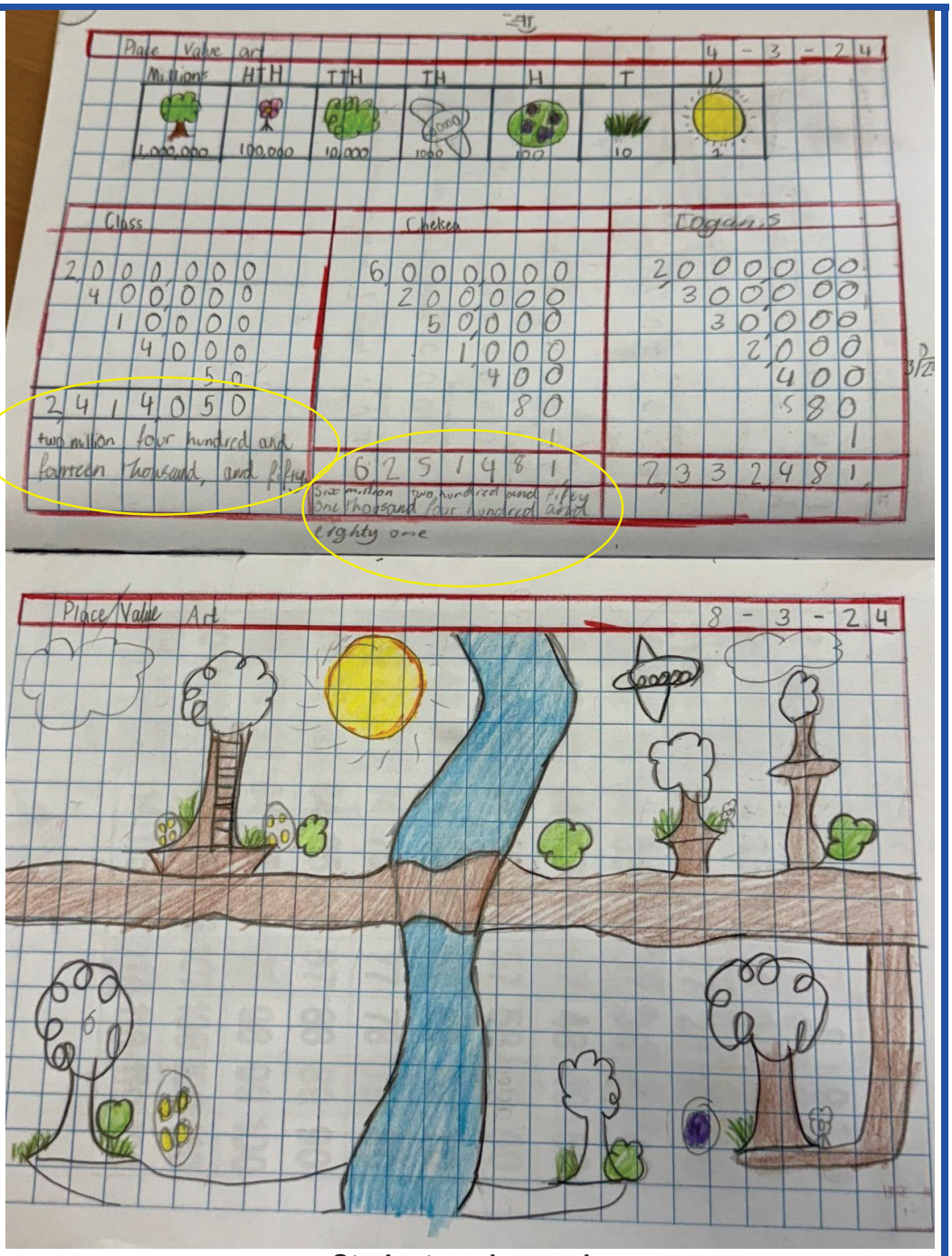
Recording – gallery walk: Students then roam to each desk and record the value of the number as above.



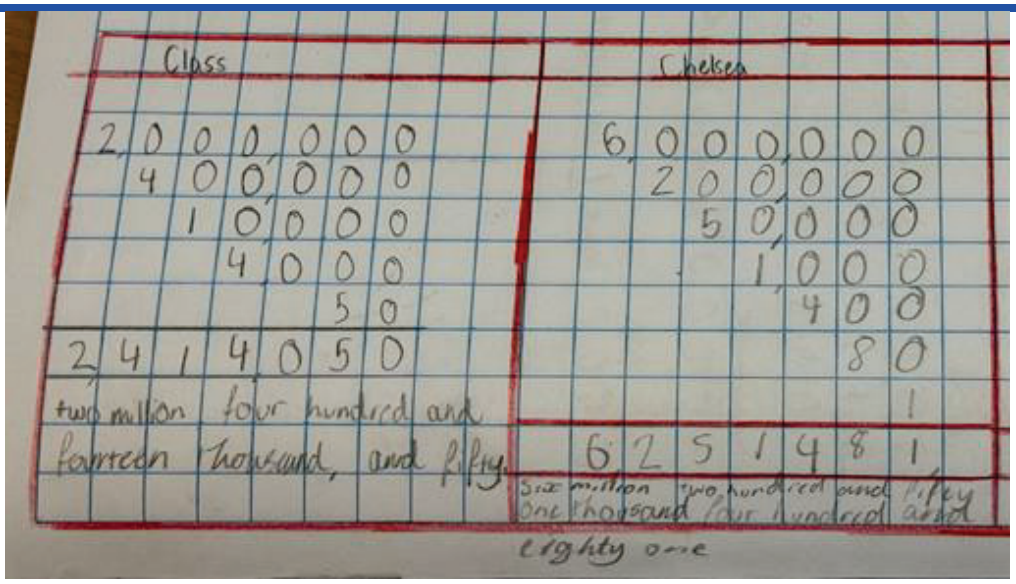
Example of the key/legend

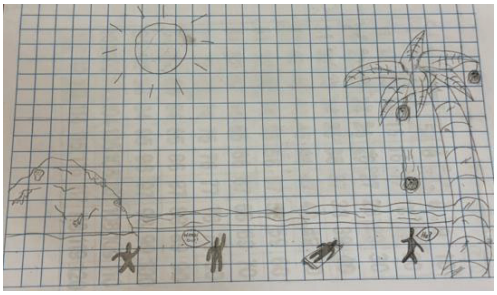


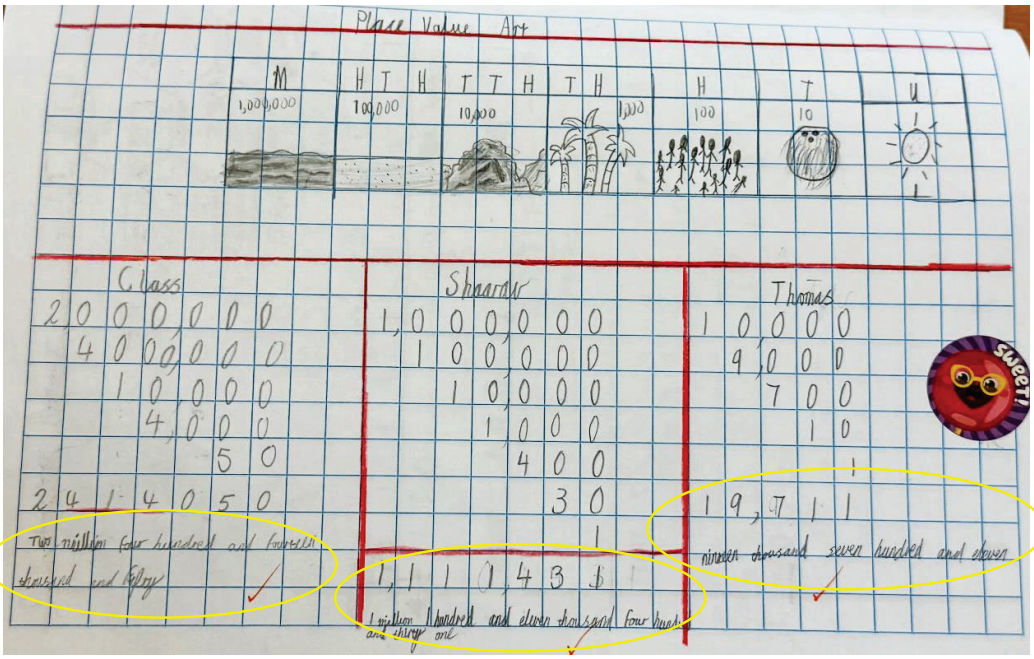
Place value key/legend



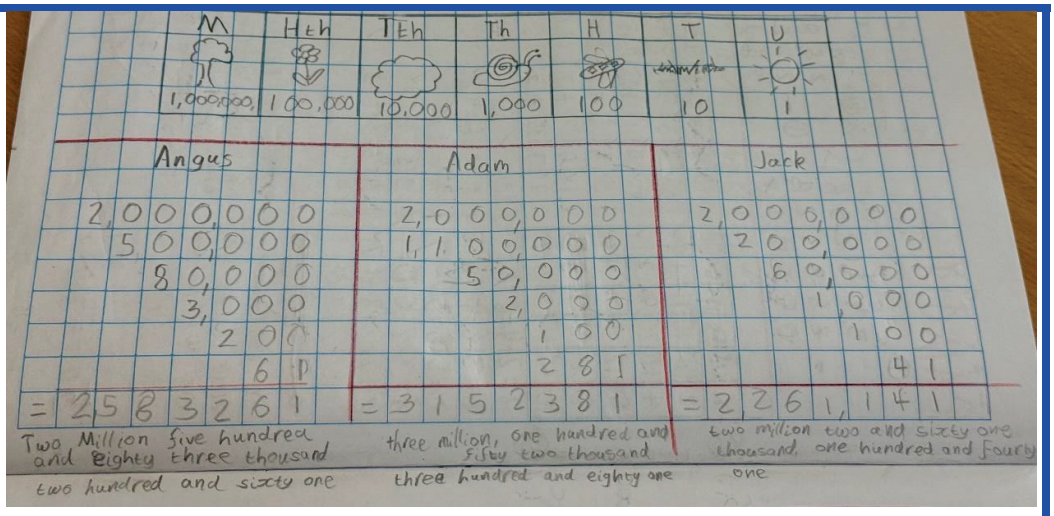
Student work sample



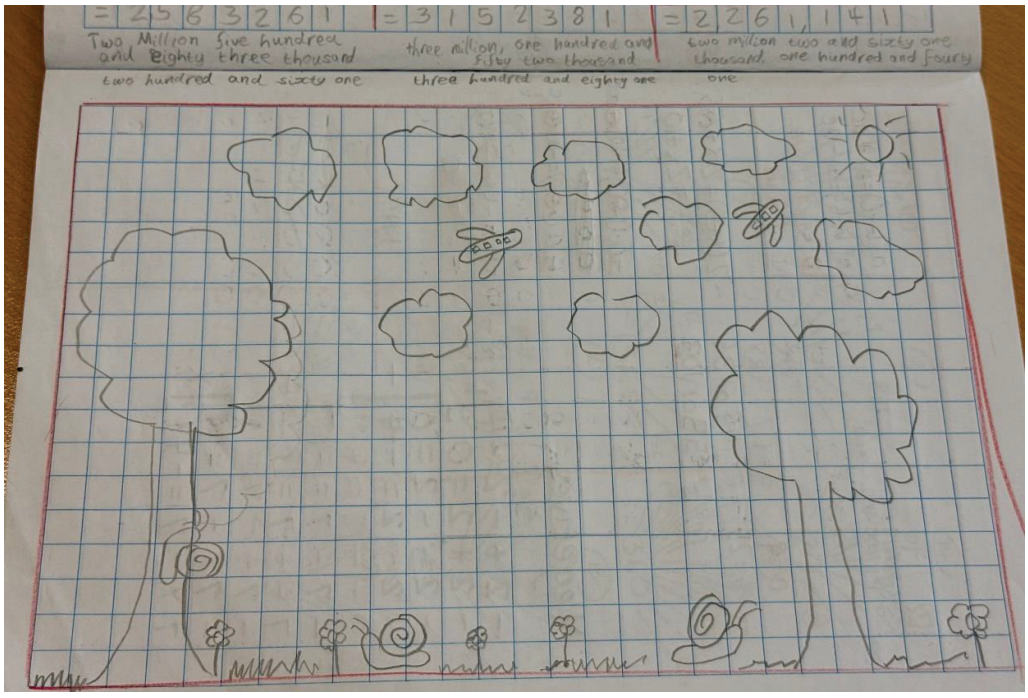




Student work samples from the 5/6 team at Chirnside Park PS



Student work samples



Repeat lesson – Second Follow-on Session

The next lesson, students each create their own place value code, which could include using any symbols of their choice (love hearts, emoticons, mini drawings of their favourite hobbies). Students write the total value of the gallery in the centre of the page, then the challenge for other students who roam is to work out the key/legend, as in, what value does each symbol represent?

Questioning:

- Estimate this gallery before you start tallying it. Where do your eyes look first – at the hexagons or the circles? Why? It would be ideal for students to try to estimate each gallery before working out its precise value, writing down their estimate in green pencil.

  E≈ (E stands for 'estimate' and the squiggly estimate is a formal symbol representing an approximation).

- Without calculating it, which of these two galleries do you think will be worth more? How did you try to solve it?

- What will be the rough difference between these two galleries? How did you try to work it out?

Support for worded form: Use this program as a check for immediate feedback on their worded form: https://lingojam.com/NumbersToWords

Also use the spelling assistance chart – cursive font or stick and ball font to reduce the literacy barriers involved in the recording.

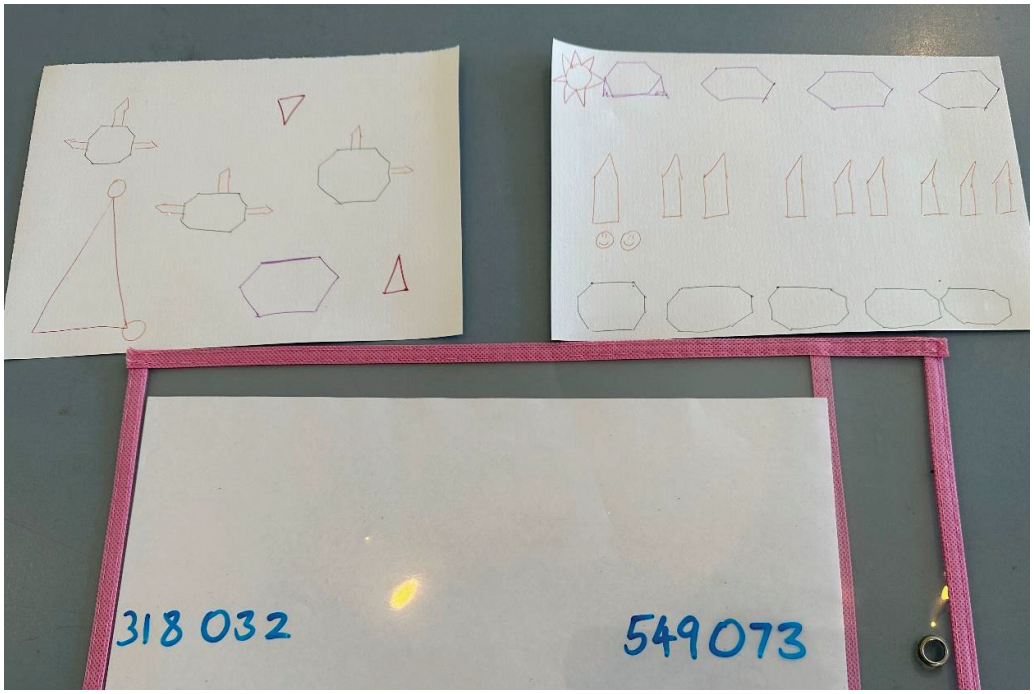
Support: Only draw the first 3 or 4 types of shapes from the key (ones, tens and hundreds), and solve like-ability classmates' galleries first.

Use a place value block bag, carrying this to each gallery. Build the gallery using place value blocks, adding a ones block for any circles they see, a tens block for any triangles, and a hundreds block for any squares.

Extension 1 – all mid-range students could attempt by the second repeat session: Try to solve the total of two galleries mentally.

Extension 2 – Jump the difference: Try to solve the difference between two galleries mentally. A great strategy, depending on the numbers involved, is often to start at the lower number and jump/build up to the next ten, hundred, and so on.

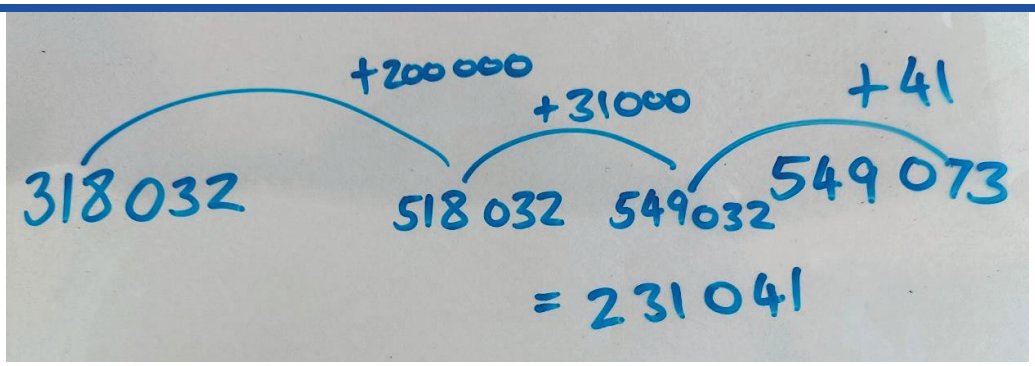
For example, for any two galleries, the student would first work out both their values and could write this down on paper, or a write and wipe board, like so:



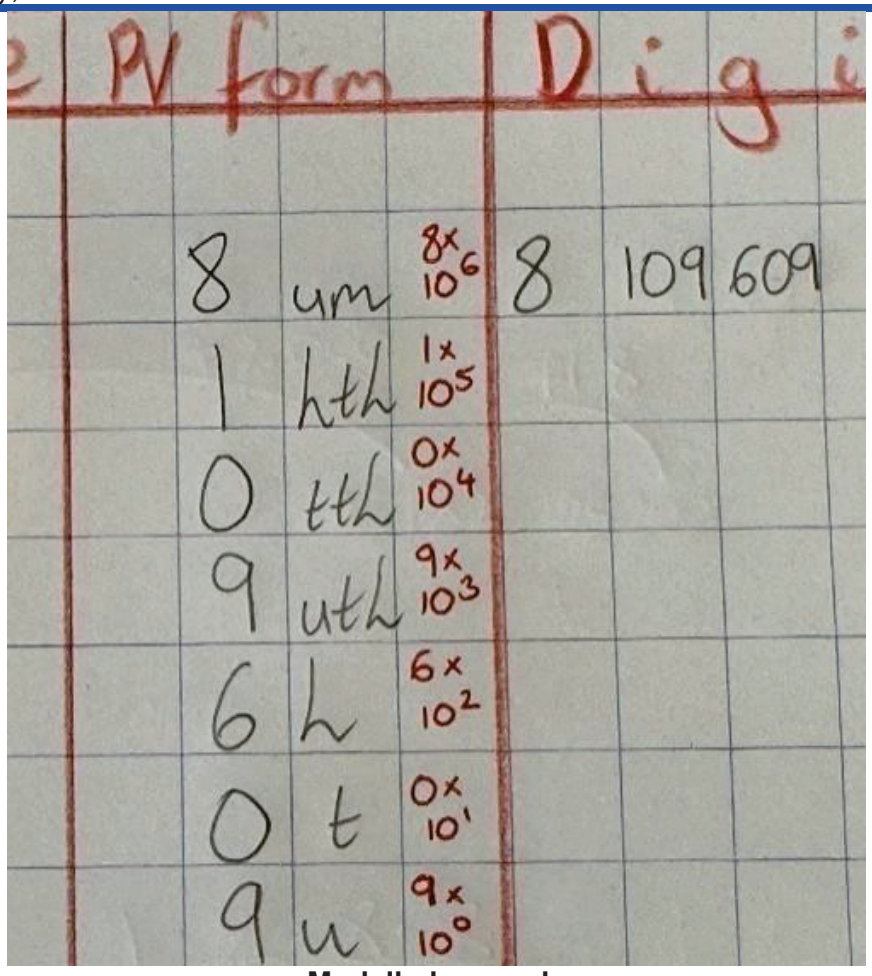
Try to work out the difference mentally only, without writing on the paper or board at first.

Jump the difference strategy – mentally: Start from 318 032, jump 2 hundred thousand to 518 032. Keep this number in your head, an add on 31 thousand, to make it 549 032. Then just add another 41. Altogether, you added 231 041. That is the difference.

Check with a written method, such as a jump the difference strategy on a number line:



Finally, check with a calculator.



Modelled example

Extension 3: Following on from the previous lesson's extension, try to write the galleries using scientific notation.

Emphasise that 10^1 (read as 10 to the power of 1) = 10 x 1. 10^2 is not 10 x 2, but 10 x 10, so 100. 10^3 is 10 x 10 x 10 = 1000, and so on.

