TOP
The Power and Joy of Hands-on Numeracy
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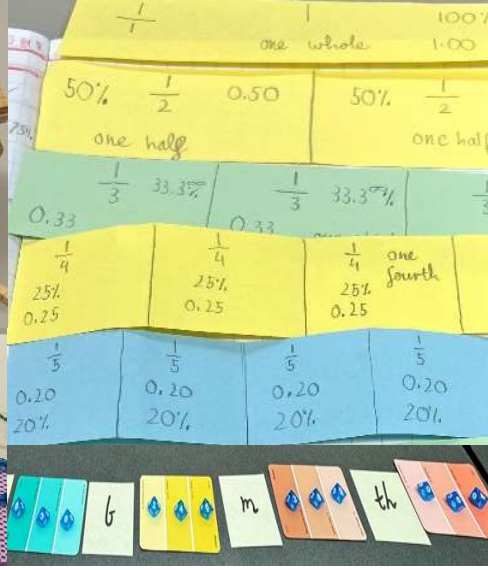
Place Value Year 3B

Recommended for Year 3

Rounding and Number Lines



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

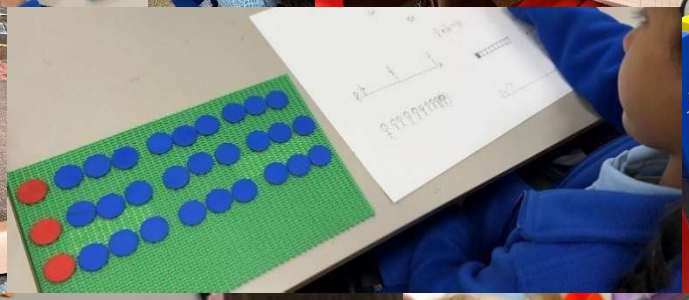
Ten years of development in Australian classrooms.

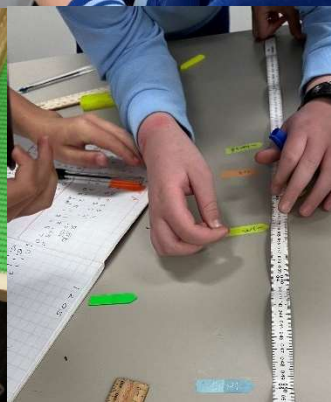
Genuinely high engagement and conceptual understanding in middle to upper primary numeracy.

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 in the absence of 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 students' points-of-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 Unit for Year 3 – 3B Rounding and Number Lines Hyperlinked Table of Contents

Place Value Unit for Year 3

Curriculum Links for the following lessons

This unit is recommended for Year 3 students.

Australian Curriculum V9 AC9M3N01 and Victorian Curriculum Version 2.0 (VC2M3N02)

Number – Level 3: Recognise, represent and order natural numbers using naming and writing conventions for numerals beyond 10 000

- moving materials from one place to another on a place value model to show renaming of numbers (for example, 1574 can be shown as one thousand, 5 hundreds, 7 tens and 4 ones, or as 15 hundreds, 7 tens and 4 ones)
- using the repeating pattern of place value names and spaces within sets of 3 digits to name and write larger numbers: ones, tens, hundreds, ones of thousands, tens of thousands, hundreds of thousands, ones of millions, tens of millions; for example, writing four hundred and twenty-five thousand as 425 000
- predicting and naming the number that is one more than 99, 109, 199, 1009, 1099, 1999, 10 009 … 99 999 and discussing what will change when one, one ten and one hundred is added to each
- comparing the Hindu-Arabic numeral system to other numeral systems; for example, investigating the Japanese numeral system, 一、十、百、千、万
- comparing, reading and writing the numbers involved in more than 60 000 years of Aboriginal and Torres Strait Islander Peoples' presence on the Australian continent through timescales relating to pre-colonisation and post-colonisation

Australian Curriculum V9 AC9M3N05 and Victorian Curriculum Version 2.0 (VC2M3N06)

Number – Level 3: Estimate the quantity of objects in collections and make estimates when solving problems to determine the reasonableness of calculations

- **estimating** how much space a grid paper representation of a large number such as 20 200 will take up on the wall and how much paper will be required
- **estimating the number of people in a large gathering (for example, a school assembly) using known numbers (such as how many students per class)**
- **choosing which place value they would estimate to for different situations; for example, choosing to estimate to the nearest ten when estimating how many dots on a ladybird or choosing to estimate to the nearest thousand when estimating crowd sizes at a venue**
- **checking the reasonableness of an addition calculation by using two- and three-digit numbers to the nearest ten or hundred to estimate; for example, using 200 + 400 = 600 to estimate and check the solution to the calculation 219 + 385**

Western Australian Number and Place Value – Level 3: Recognise, model, represent and order numbers to at least 10 000 (ACMNA052)

- placing four-digit numbers on a number line using an appropriate scale
- reproducing numbers in words using their numerical representations and vice versa.

Western Australian Number and Place Value – Level 3: Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems (ACMNA053)

- recognising that 10 000 equals 10 thousands, 100 hundreds, 1000 tens and 10 000 ones
- justifying choices about partitioning and regrouping numbers in terms of their usefulness for particular calculations.

NSW Syllabus – Stage 2 – Representing numbers using place value A

Whole numbers: Read, represent and order numbers to thousands

- Group physical or virtual objects to show the structure of tens, hundreds and a thousand
- Regroup numbers flexibly, recognising one thousand as 10 hundreds and one hundred as 10 tens or 100 ones
- **Compare and describe the relative size of numbers by positioning numbers on a number line (Reasons about quantity)**
- Count forwards and backwards by tens and hundreds on and off the decade
- Represent numbers up to and including thousands using physical or virtual manipulatives, words, numerals, diagrams and digital displays
- Read and order numbers of up to at least 4 digits
- Identify the number before and after a number with an internal zero digit

Whole numbers: Apply place value to partition and regroup numbers up to 4 digits

- Record numbers using standard place value form
- Partition numbers of up to 4 digits in non-standard forms (Reasons about quantity)

NSW Syllabus – Stage 2 – Representing numbers using place value B

Whole numbers: Order numbers in the thousands

- Arrange numbers in the thousands in ascending and descending order
- Recognise and describe how rearranging digits changes the size of a number (Reasons about relations)
- **Identify the nearest thousand, 10 thousand or 100 thousand to numbers**

Whole numbers: Apply place value to partition, regroup and rename numbers up to 6 digits

- Name thousands using the place value grouping of ones, tens and hundreds of thousands
- Use place value to expand the number notation
- Partition numbers of up to 6 digits in non-standard forms

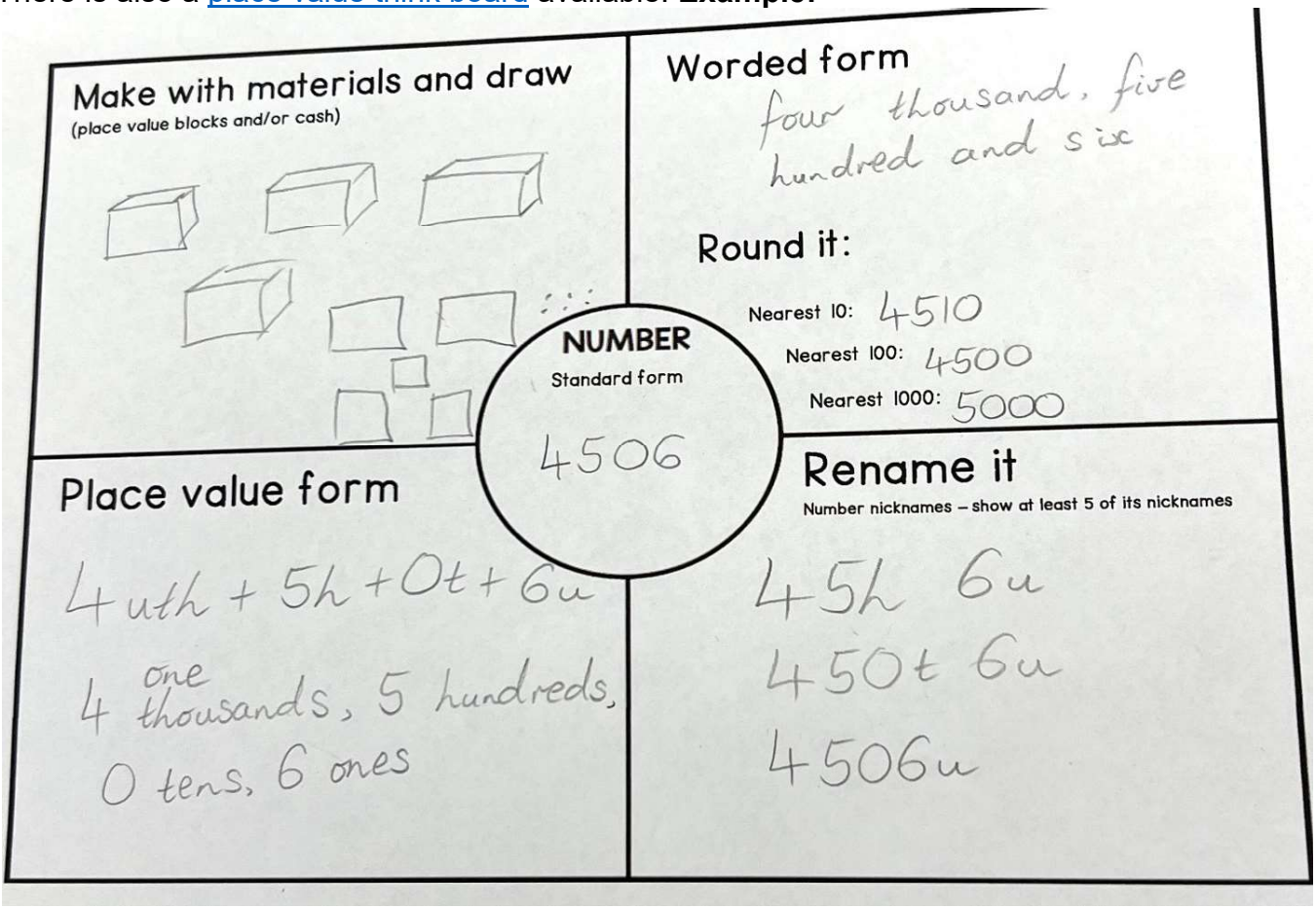
Whole numbers: Recognise and represent numbers that are 10, 100 or 1000 times as large

- Recognise the number of tens, hundreds or thousands in a number
- Describe how making a number 10, 100 or 1000 times as large changes the place value of digits

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:**

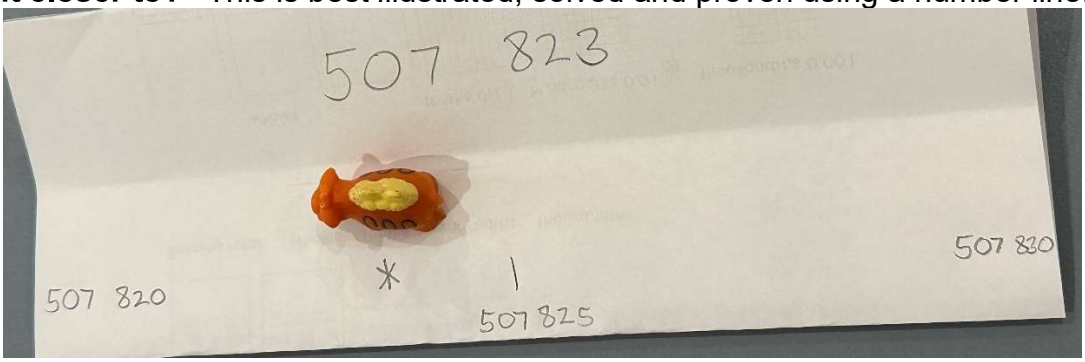


The ghost of place value past shall haunt you all year...

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 – 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.



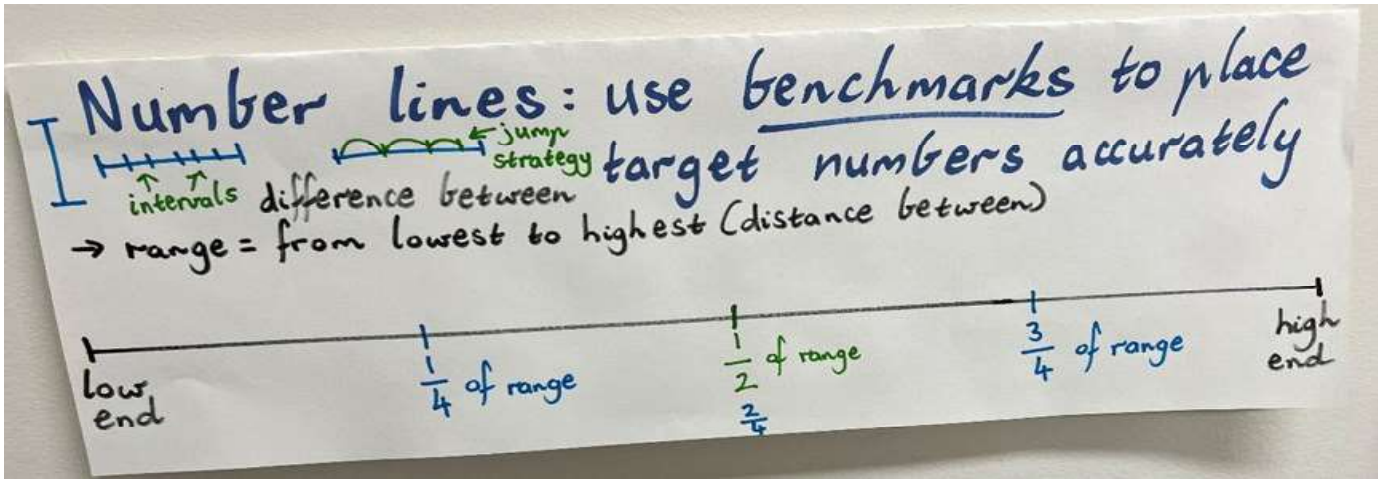
Rote rules relating to underlining the place next door, and so on, often falter in students’ memories when they are conceptually challenged, and also do not create genuine number sense in terms of number line awareness. These fragile procedures frequently fall to pieces when students are asked to round 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.

According to this large-scale study summarised by Clarke and colleagues (et al, 2008), 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…).

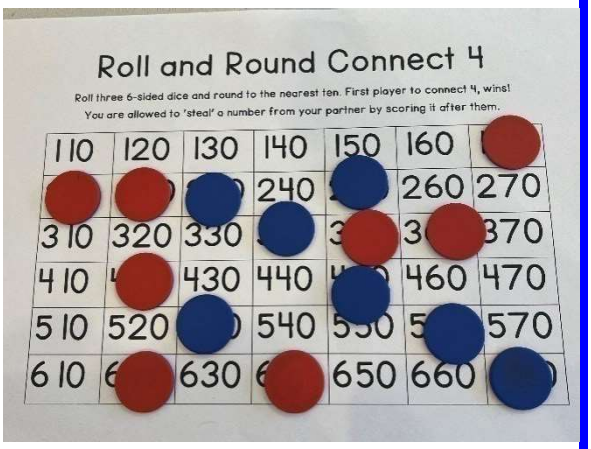
The reason that 5 rounds up is not simply by rule/convention – there is a mathematical basis for it. How many digits are there? There are 10 digits, including zero. So if we count on one hand – 5 digits go down, and 5 go up. That is an even or fair share for situations in life when we round down, and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



Roll and Round Connect 4

Focus: Rounding to ten within hundreds numbers.

Students roll three 6-sided dice to form a 3-digit number, then round to its nearest ten, aiming to 'connect 4' before their partner on the gameboard.



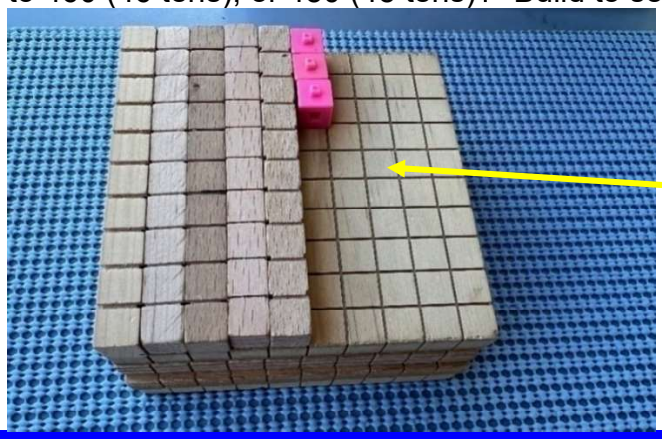
Template available ([Roll and Round Connect 4])

Here, the student using the blue counters has just achieved connect 4:

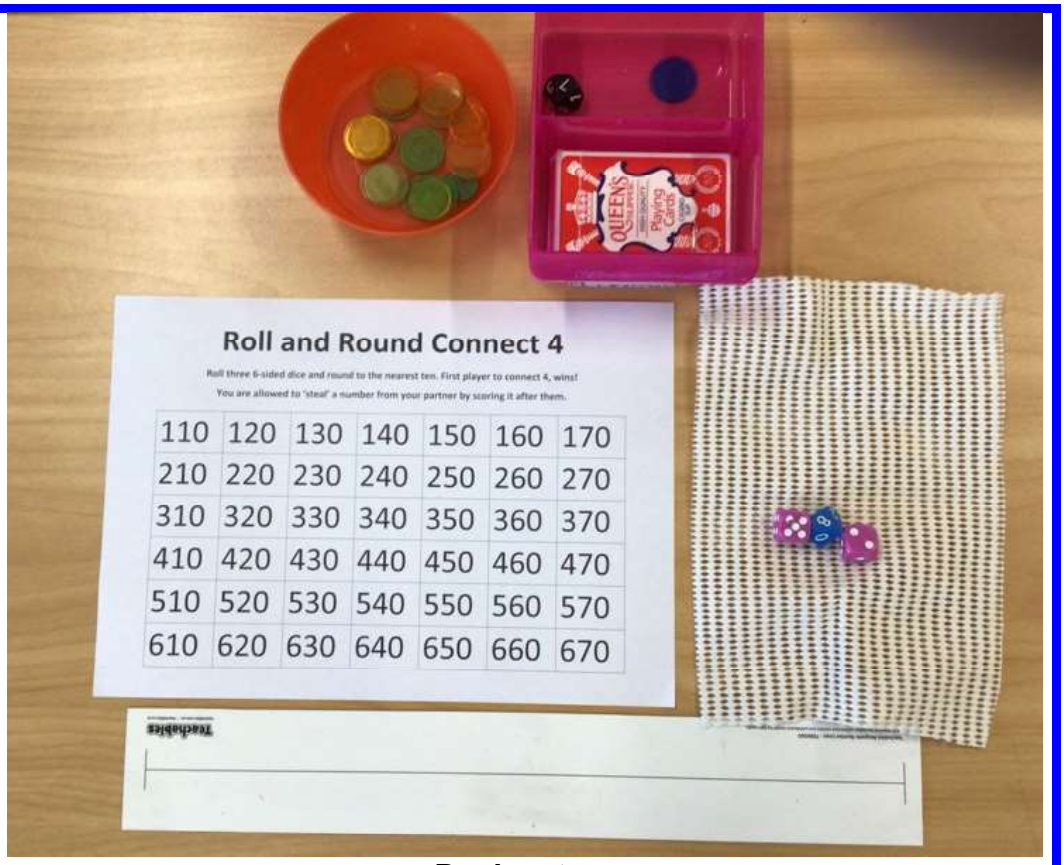
Link to the language of geometry: Since the game is Connect 4, this is an ideal time to revise the language of vertical, horizontal and diagonal. Use the vertical, diagonal and horizontal dance – see this link: https://youtu.be/C9Y5Byfw9As

Always think, 'What ten am I closer to?' rather than trying to apply some rote-based rule relating to identifying a particular place value's digit and whether it is 5 or more.

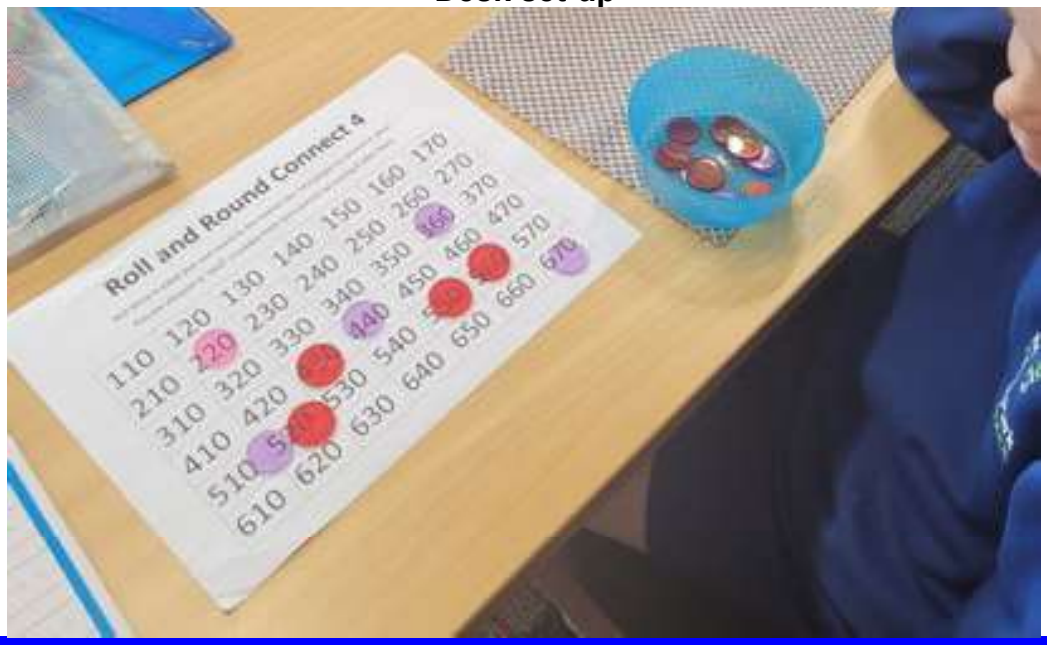
For assistance, students could build each number they roll with place value blocks, then see whether it looks closer to the next ten, or closer to the previous ten. For example, for 453 – ask, "Is it closer to 460 (46 tens), or 450 (45 tens)?" Build to see:

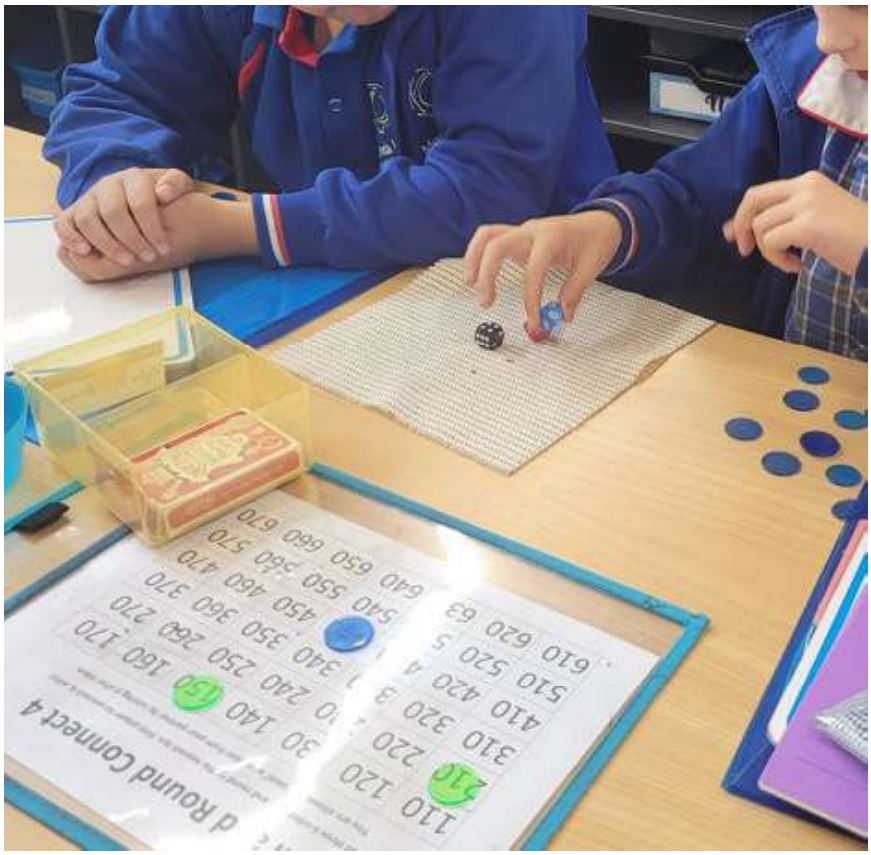


Looks closer to empty than full (closer to the ten it is in, than the next ten) so it stays in the same ten (450).

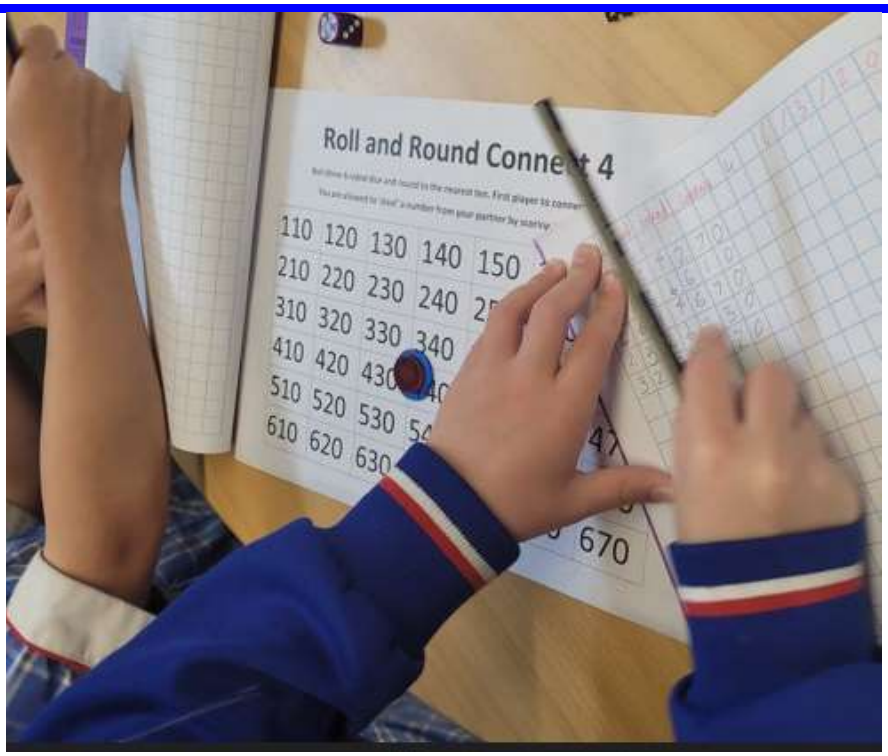


Desk set-up

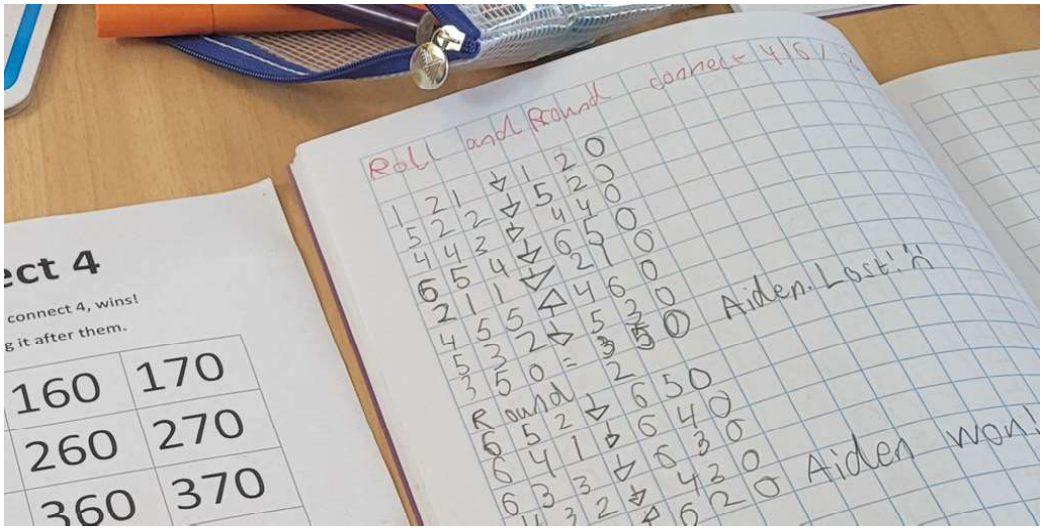




Strategically arranging the dice to score a strategic number on the gameboard.



Recording required before placing their counter on the board.



Require recording in students' grid books, before they place their counter on the gameboard.

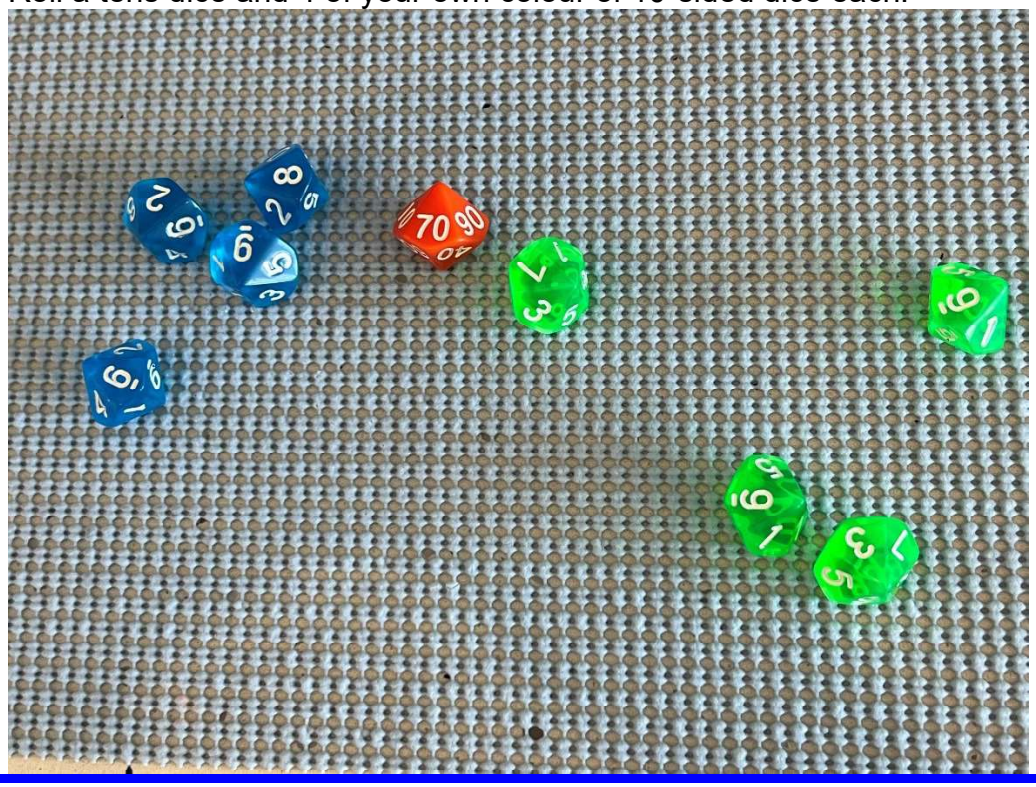
Roll and Round

Focus:
Rounding to the nearest ten.

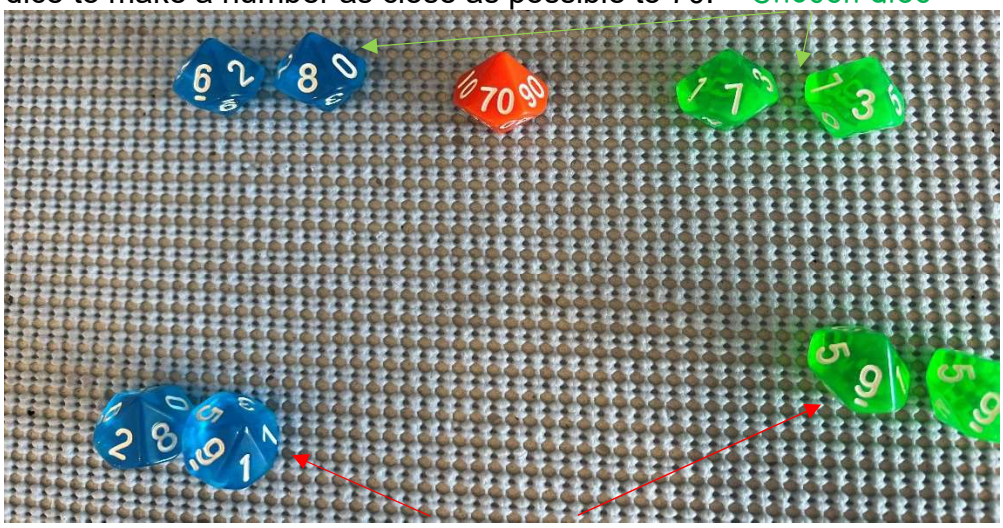
Extensions also focus on the nearest hundred and nearest thousand.

Version 1 – Closest to the tens target: Students roll a tens place value dice (a dice that has 0, 10, 20, 30, up to 90). Students then each roll four 10-sided dice (each student uses different colours, student A uses 4 blue, student B uses 4 green). Choose 2 of their dice to try to make a 2-digit number that rounds to the tens target.

Roll a tens dice and 4 of your own colour of 10-sided dice each:



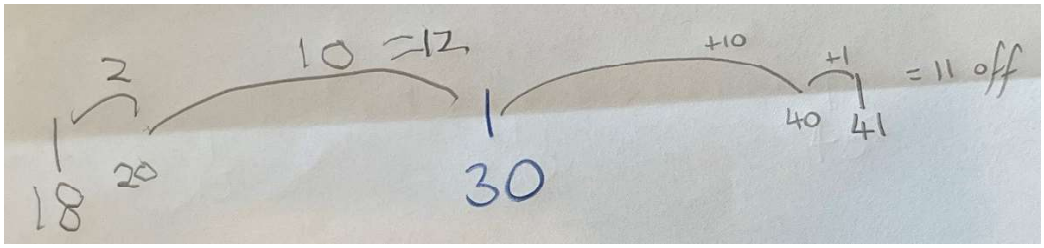
Blue dice belong to student A, green belong to student B.
The tens place value 'rounding target' dice rolled 70. So use your own dice to make a number as close as possible to 70.



Alternative material: If you do not have tens place value dice, ask students to write '10, 20, 30, 40, and so on up to 90' onto post-it notes. Scrunch these up, pour into a cup, shake and pull one out.

Scoring mechanism: Successfully rounds to the target = 5 points. If the winning or losing player's number is the closest to the target (closer than the other player's number) = 5 additional points. So the winner can earn 10 points each round; runner-up can still earn 5 points if their number rounds to the target (but was just not the closest).

Example game: The tens place value dice rolled 30. The four 10-sided dice rolled were 4, 5, 8 and 1. Students now need to think about which two dice they want to use to make a number that is as close as possible to 30. Student A might choose to make 18, while student B might make 41. Neither round to 30, so no one wins the first 5 points on offer. But the second 5 points is won by whoever is closer. Who is closer? One method could be to use an open number line and jump strategy to work it out for each of their own numbers, with the target written in the middle, like so:



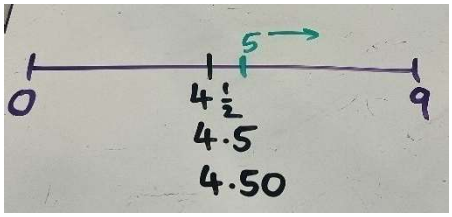
41 is 11 'off' 30, whereas 18 is 12 'off' 30, so '41' wins!

Critical teaching language to avoid rote-based rules: "What is your number closest to?" or, "Which ten is your number (63) closest to?"

Language to avoid: "4 rounds down, 5 rounds up! Just apply that rule." Students do not know which place value to use and are not using their place value understanding of what the number is close to, which reduces this skill to a rote-based rule and makes it less likely that students will later rely on it for estimating answers to algorithms.

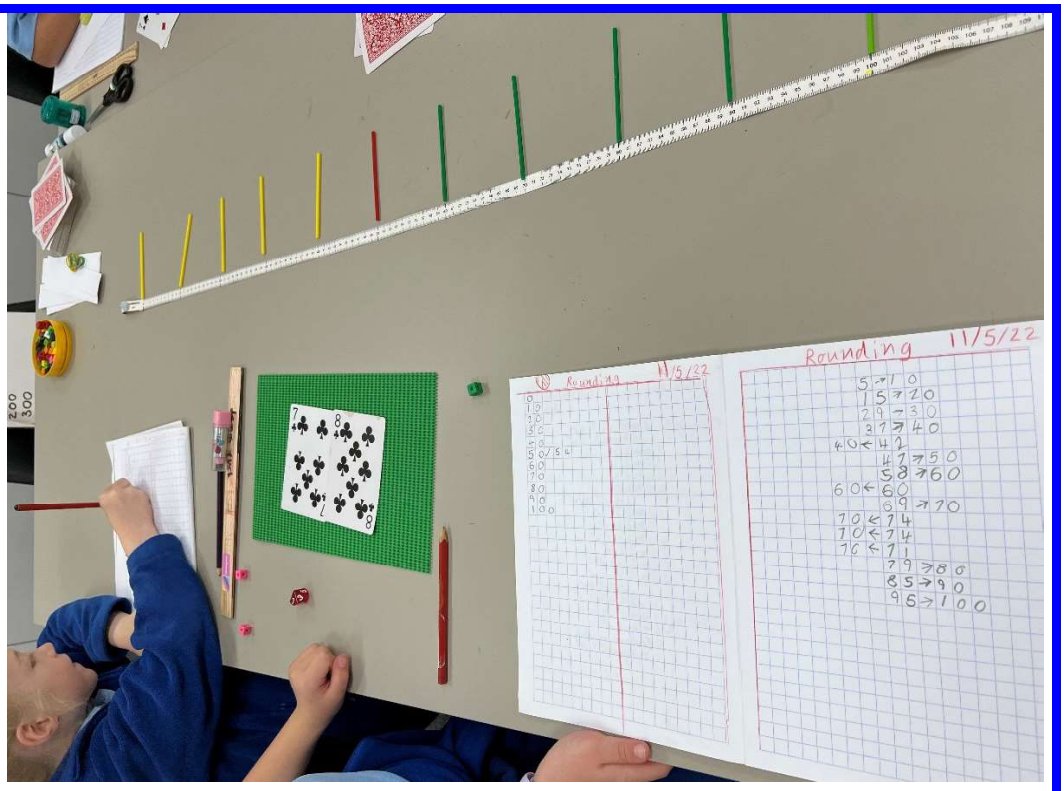
The only exception is 5. Because 5 looks like it is in the middle of either ten (see the next page for number line materials set-up to support students), we must tell students that it rounds up (even though it is in the centre). The challenge is for students to work out why? Before you read on, try to work out why 5 rounds up…

Critical explanation for why '5' rounds up: It is because there are 5 digits that round down (0, 1, 2, 3, 4) and 5 that round up (5, 6, 7, 8, 9). Or, on a number line, considering only the digits, 5 is not actually central, but like this:

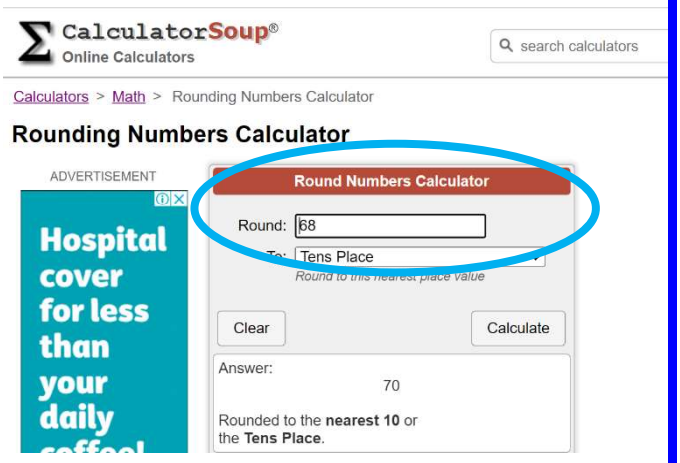


All students who need and ongoing support during this game – Use a number line to work it out, or check your answer: Set up a measuring tape on the desk from 0 to 100 to function as a number line. Place sticks along the measuring tape at each interval of 10 up to 100, and also a stick at 0 (mirroring the set up of the *Rounding Snakes and Ladders Lesson – Early Years Package Unit 14 Lesson 5*).

Students can then place a ones counter on the number they created and literally check what ten/stick their number is **closest to** – therefore, what it rounds to.



Opportunities for immediate feedback for students: Use calculator soup's rounding calculator on students' iPads to enable access to immediate feedback from their partner after they work it out themselves either mentally or using the number line set up above. Calculator soup link for rounding calculator: https://www.calculatorsoup.com/calculators/math/roundingnumbers.php



Extension 1 – Nearest to 100: Roll a hundreds place value dice (or pull post-it notes from a cup filled with hundreds numbers – 100, 200, 300, don't forget 0, which is occassionally the nearest hundred!). Each player rolls six 10-sided dice, choosing three dice to use to make the closest number to the hundreds target that was rolled.

Extension 2 – Nearest to 1000: Write ‘1000, 2000, 3000, up to 10 000,’ onto post-it notes. Scrunch up each post-it note and place inside a school hat or cup. Shake and pull out one post-it note. For example, let’s say 7000 is pulled out. Now both partners roll 8 x 10-sided dice (their own colour) and aim to make a number that is as close to 7000 as possible.

This one was a draw! Target was 3000. Student A managed to make 3015, and student B made 2985. Both players earn 5 points (both of their numbers round to the target of 3000) and an additional 5 points for the tied win (closest number to the target).

Place Value Year 3B Lesson 1

Rounding Revision: Snakes and Ladders Rounding

Learning intention: Round to the nearest ten by seeing which ten your position is closer to.

Maths vocabulary: round (closer to), nearest ten

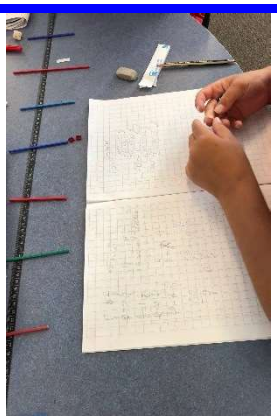
Game-based learning: Who has played snakes and ladders before? Today, we are playing the maths version of snakes and ladders! Play an online version with the class during eating time the day prior to this session: https://m.twoplayergames.org/play/snakes-and-ladders.html.

YouTube hook: One of the world's tallest ladder climbs without safety gear: https://www.youtube.com/watch?v=a2p4BOGXSBw. Another related

Lesson summary: Students race to 100 along a measuring tape (using it as a number line), moving to the rolled position and then sliding up to the next ten if they roll 5-9 on the 10-sided die, but going back to the lower ten if they roll 0-4. *Do not tell students this – let them figure it out by seeing which ten they are closer to as they play the game.*

Materials:

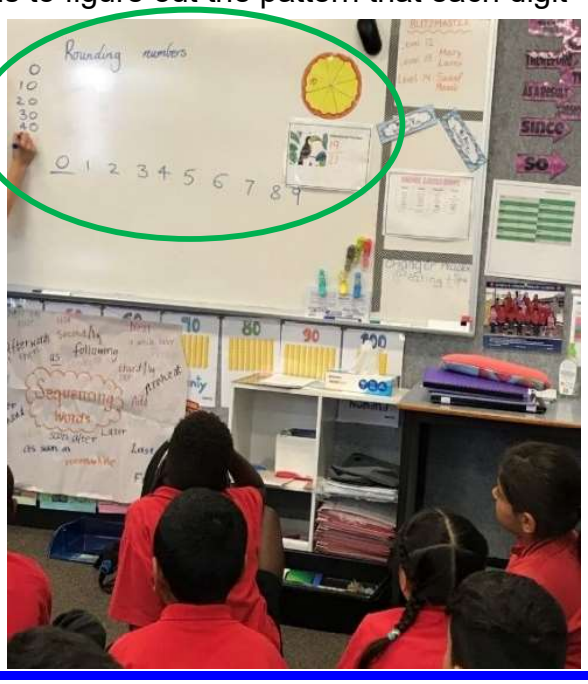
- 1.5m/150cm measuring tape stuck to the students' desks with Blu tac.
- Thin bundling sticks (preferable) or popsicle sticks to mark each ten along the measuring tape – put a stick at 0, 10, 20, 30 up to 150.
- Small counters (one per student) to mark their current position, such as a ones place value block or other 1cm^3 counter (it must be 1cm or less in width).
- 10-sided die – one per pair.



Best set-up: Fishbowl model, then like-ability pairs or mixed-ability tables.

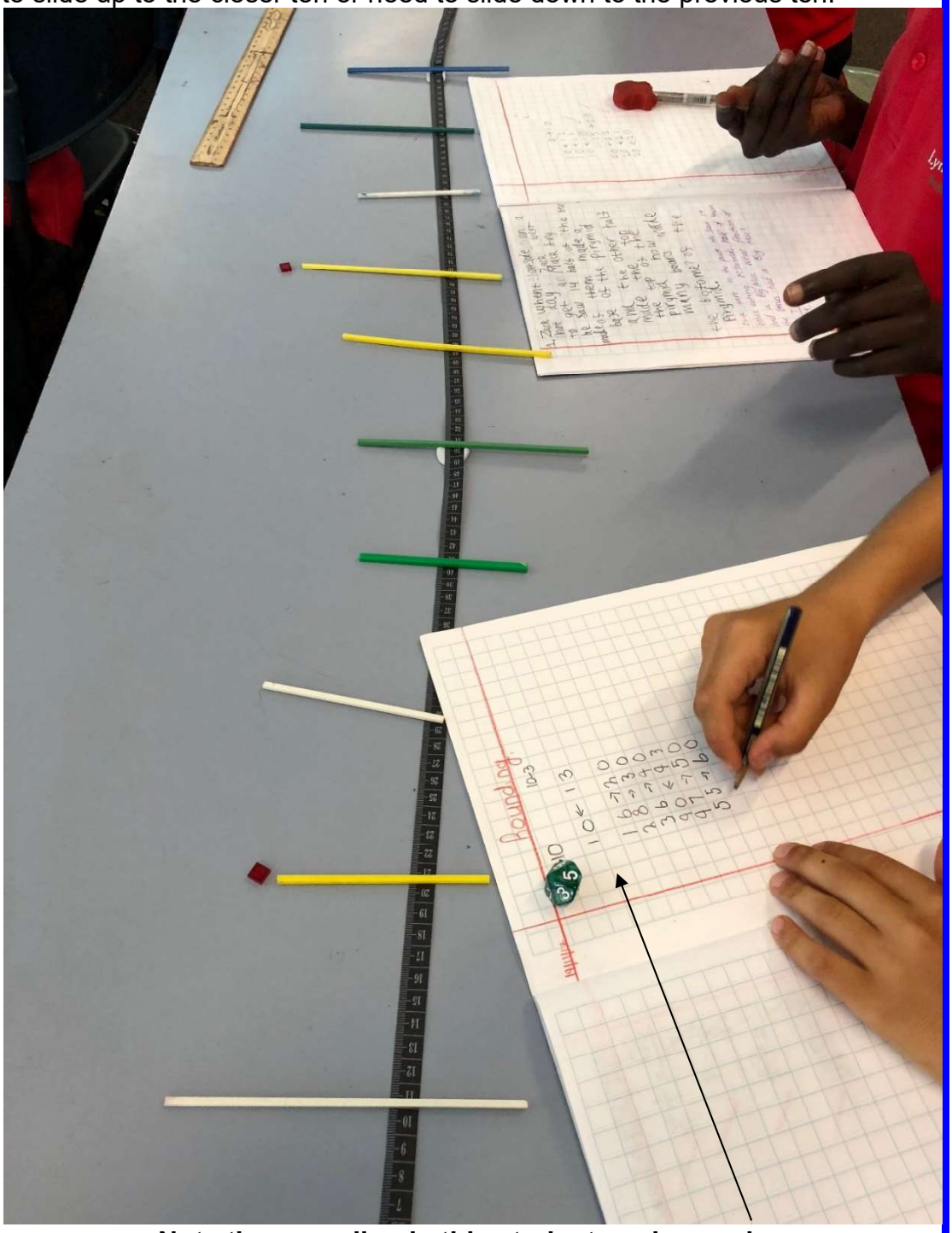
Modelling: Write all the digits on the board. Make the distinction between digits and numbers. Digits are like the letters in the number alphabet, numbers are like the words. Letters are used to make words, digits are used to make numbers. Digits follow certain patterns when we round them to the nearest ten. Today, your challenge is to figure out the pattern that each digit follows and why. ***Tip:*** Don't 'give away the gold/answers' by telling students straight away that 0-4 stay in the same ten and 5-9 rounds up!

Referring to all the digits on the board – Which digit looks the most round – the most alike to a circle? Some students will say 8 but most will say it is 0. Therefore, all our rounding numbers will end in zero. Like renaming, ten is also an important number in our place value system for rounding. Ask students to count by 10, "0, 10, 20, 30, 40…up to 220." Those are tens numbers and can therefore be the nearest ten.



YouTube clip – a countdown of some of the world's longest snakes: https://www.youtube.com/watch?v=WViqKHq96mw. Play during eating times surrounding the sessions because the clip is 6 minutes long.

Fishbowl model the game with a student partner around a demonstration desk. First, set up an example desk (which could be the desk of your support pair) with the measuring tape as the number line, with 0 on the left, counting by 10s to place the counting sticks along the line. These sticks are effectively the ladders of the game or the snakes, depending on whether students get to slide up to the closer ten or need to slide down to the previous ten.



Note the recording in this student work sample.

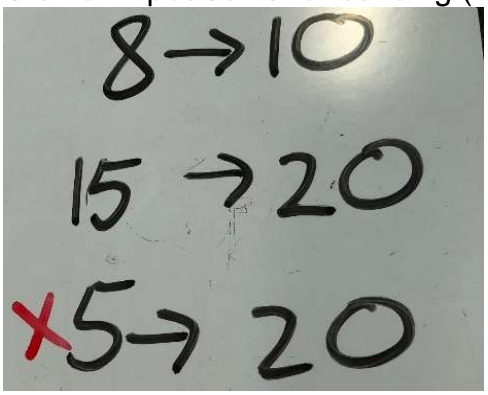
Modelling: Start at 0. Roll the 10-sided dice. For example, if you roll 3, put your counter on '3.' Which ten stick am I closer to? 0 or 10? 0, so that is a snake – oh no! Next turn, you roll 7. You are closer to 10 than 0, so can move to 10 – woohoo! Next turn, you roll 2, so move to 12. Are you closer to 10 or 20? You are closer to 10, so back you go!
To record, students write the number they landed on in the centre of their page, '3,' then use an arrow to show the tens number they rounded to:

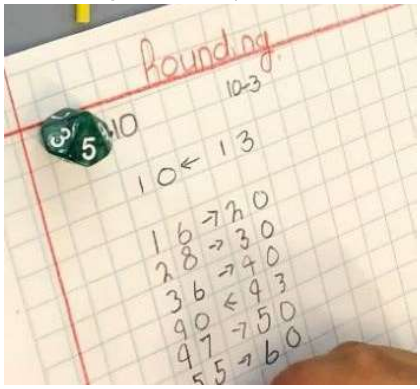
0 ⟸ 3

If a student rolled '7' and they were on 30, they would record it like this:

37 ⟹ 40

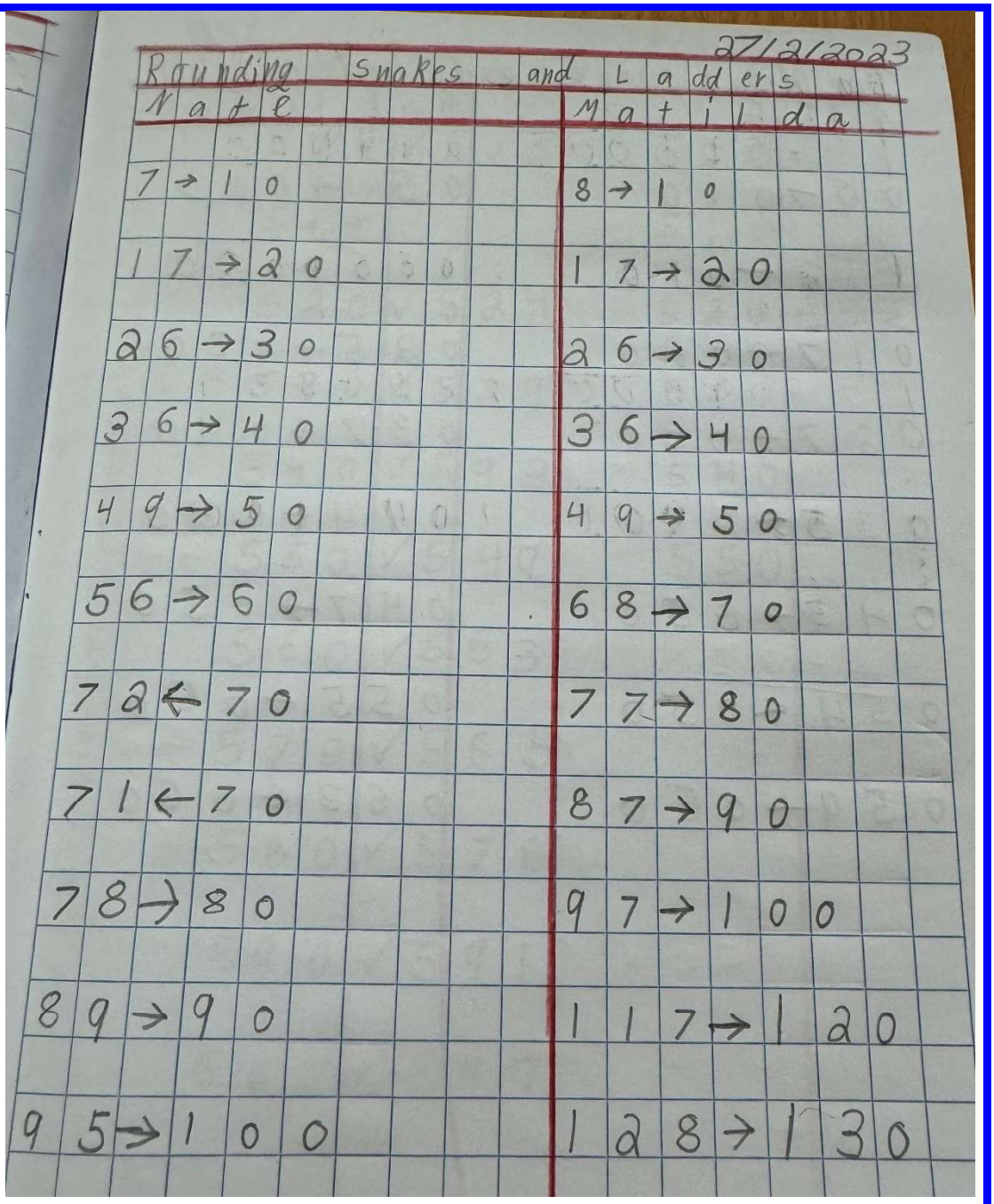
Misconception alert: Emphasise that students should not record this as '7 to 40', because 7 does not round to 40! 37 rounds to 40, and you were on 37 not 7. If you record '7,' not '37,' I will have to slide you back to '7' when I see this, which will give your partner a *huge* advantage. This is a fairly common mistake so model for students to avoid this from the start of the session during your fishbowl. Students must record as they play, but only need to record their own position and rounding (not their partner's):



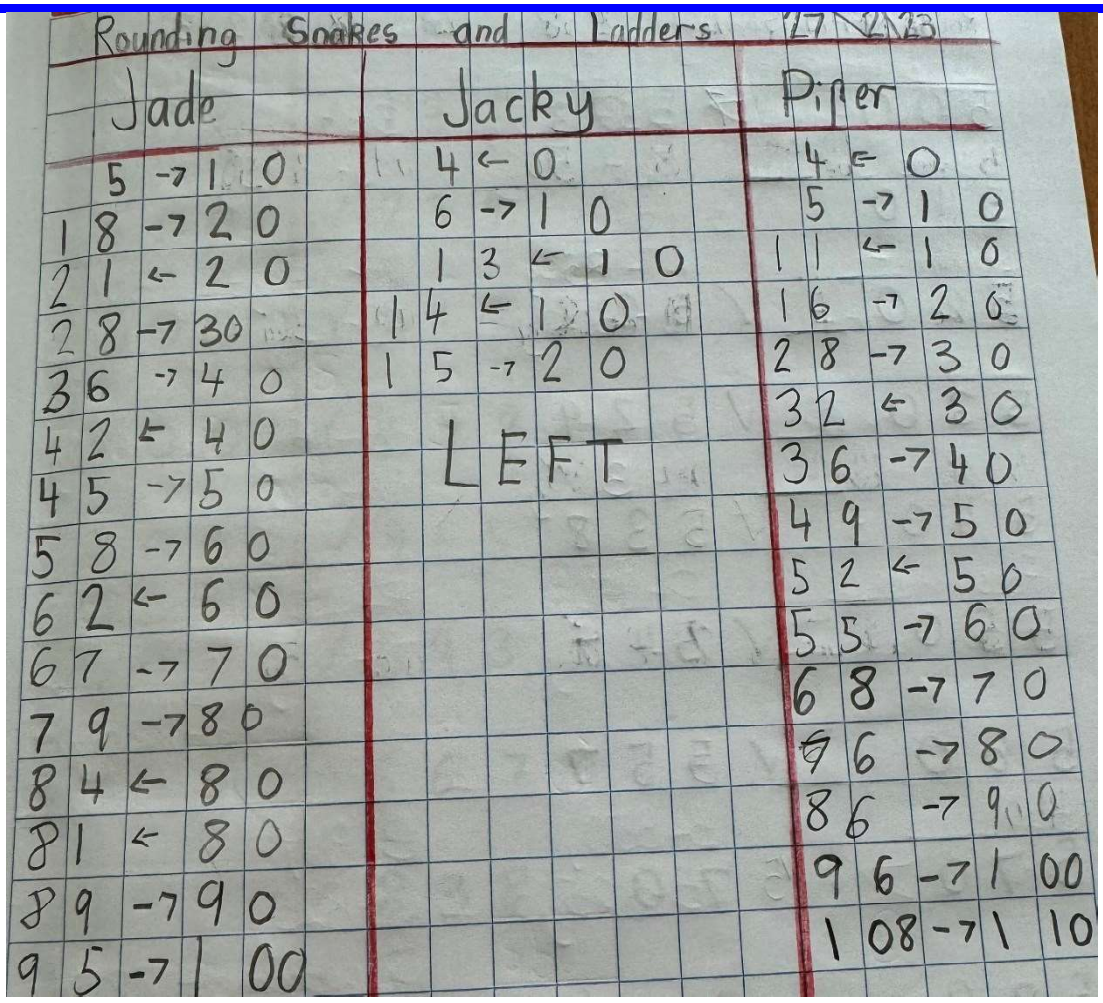


Questioning:

- What if I rolled 5? Well, it is right in the middle, so of course you are going to choose to use it as a ladder, not a snake. Later in the session (once students have had time to discover the pattern) set a 5-minute brainstorm challenge based on this question: Why does 5 round up even though it is right in the middle of either ten? Give students time to brainstorm reasons. The reason 5 rounds up is due to how many digits there are in our number system. We have 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. So, 5 is part of the 5-9 club to make it an even split.

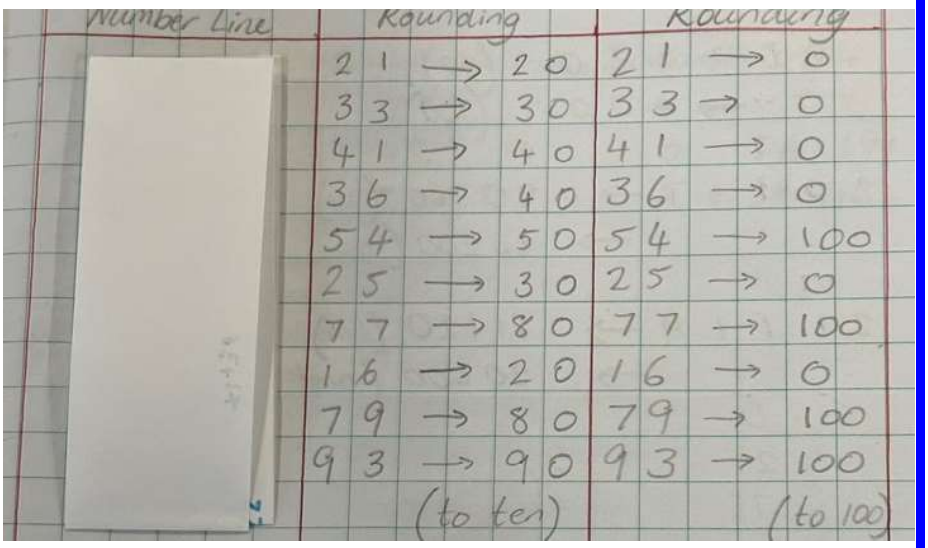


Student work sample recording their and their partner's turns.

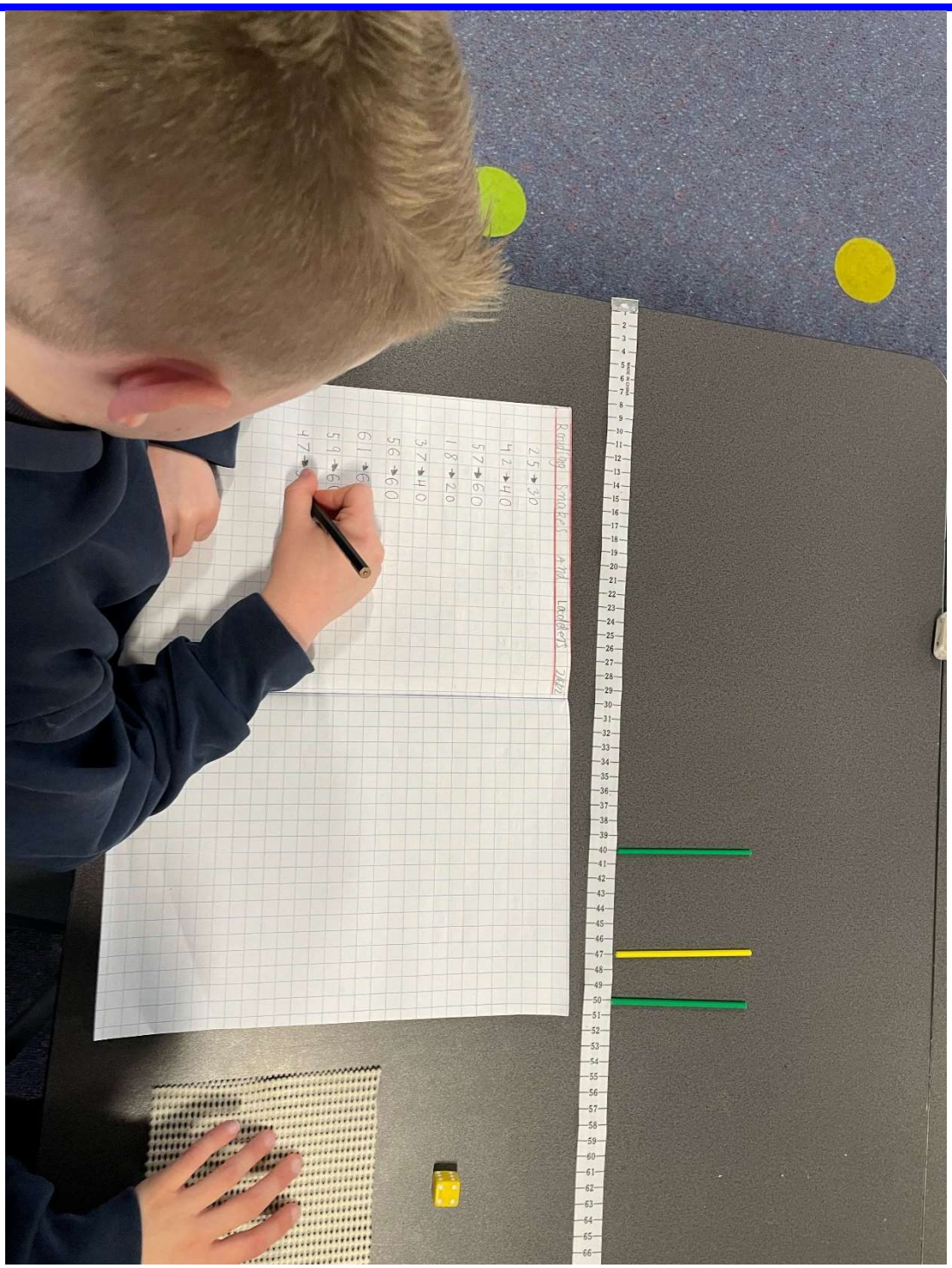


Group of 3 students where one needed to leave part of the way through for a music lesson.

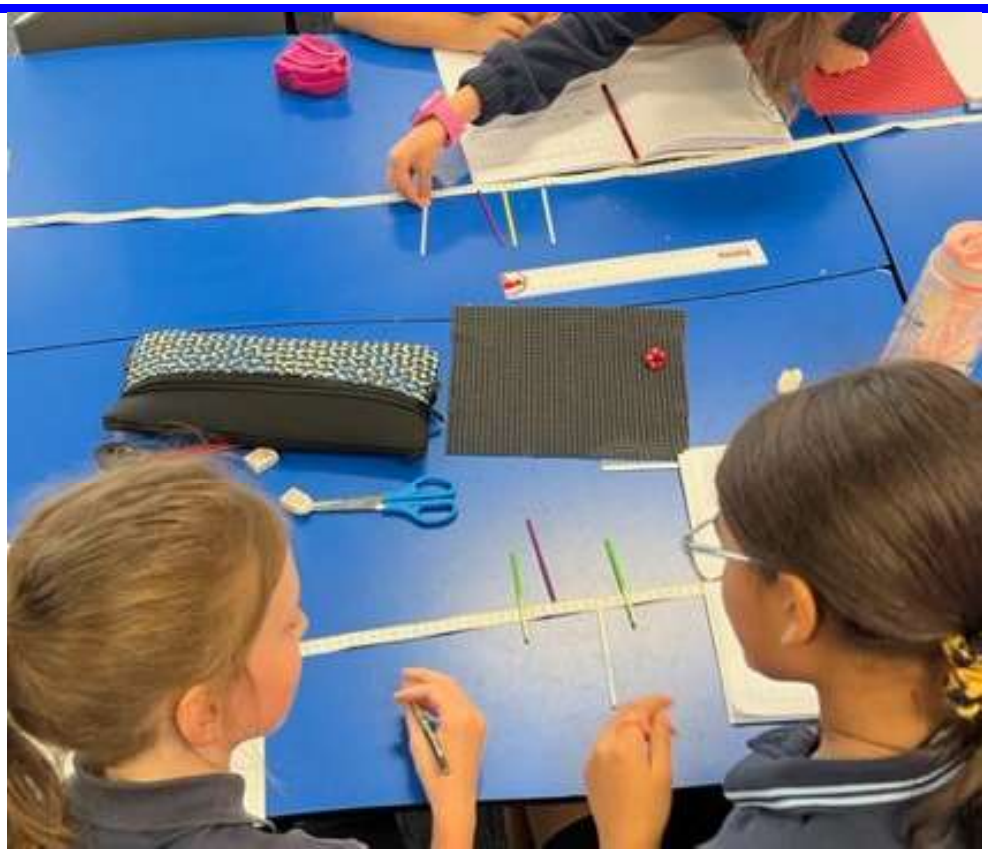
Place a green stick at 100, red at 0, yellow at 50, and also round each number rolled to the nearest hundred:



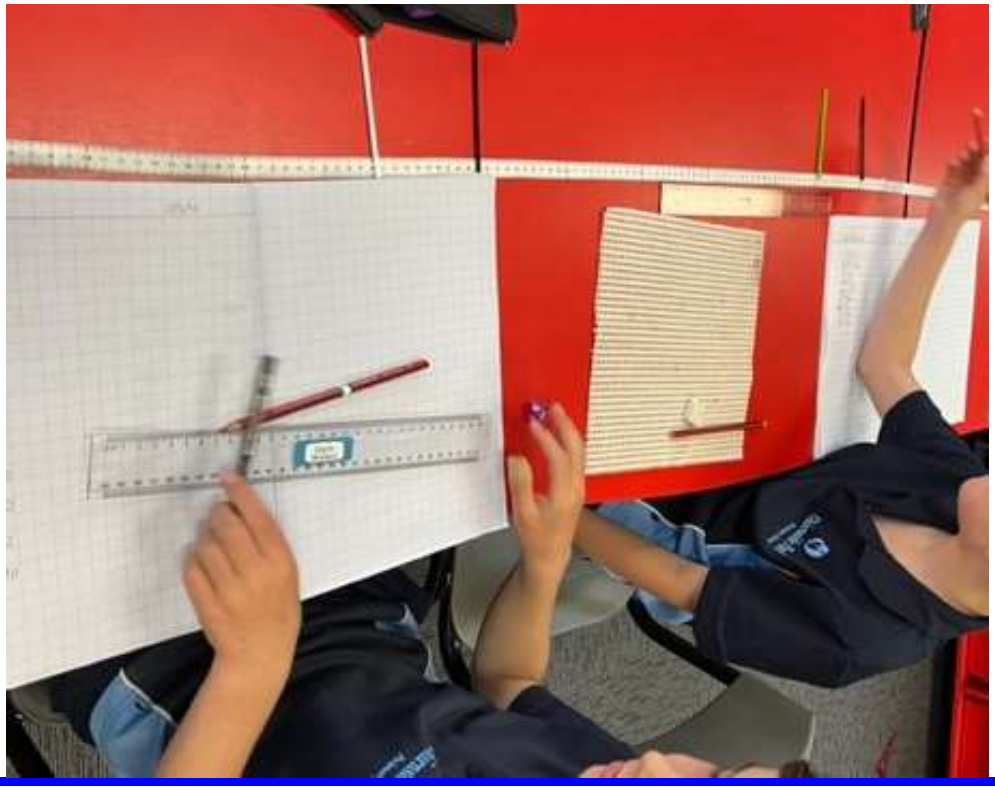
The left column is a number line folded up, the centre is rounding to the nearest ten, and the far right is rounding to the nearest hundred.

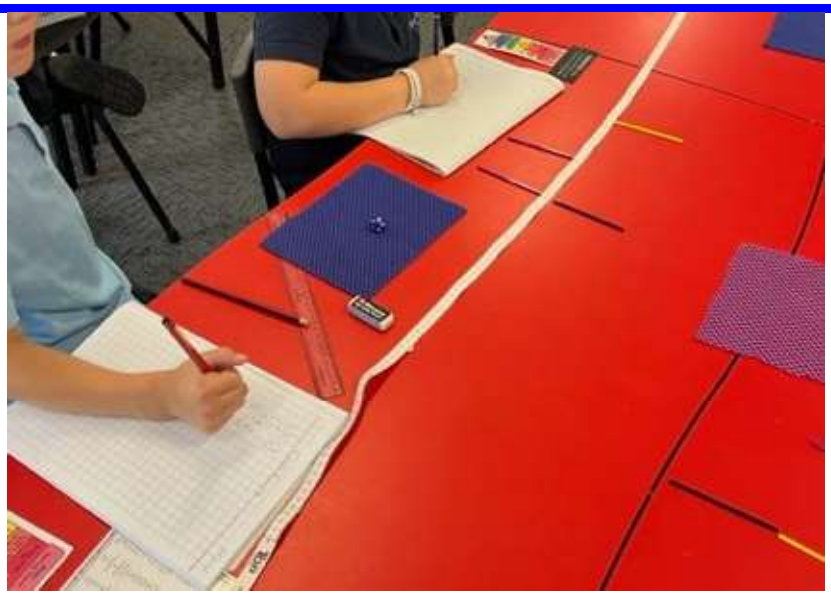


Lesson in action at Chirnside Park PS

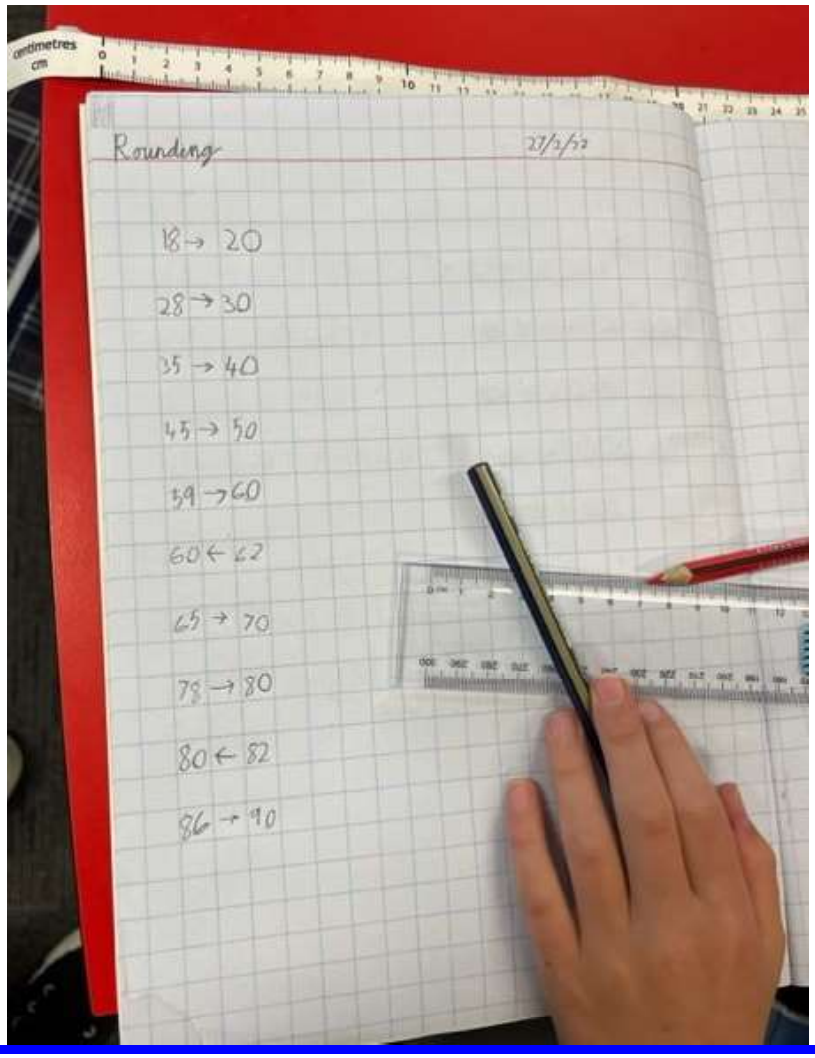


Lesson in action





Lesson in action



Support: Use a giant number line along the floor to assist them to use their own bodies to figure out which ten they are closer to, racing to 30 instead of 100, then restarting back at zero once either player reaches 30.

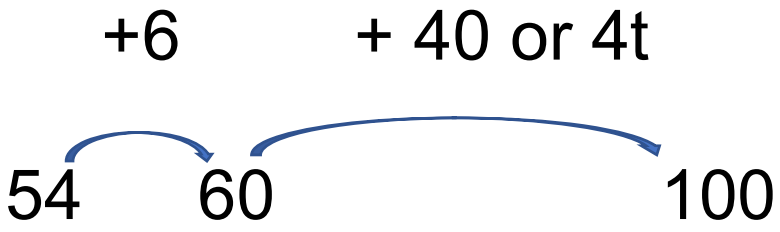
Extreme support: Play an actual game of snakes and ladders to focus on one-to-one correspondence, rather than rounding. Use this context to practise counting to 100 (saying each number they land on) and also subitising (seeing the number they rolled on the die straight away) without needing to physically count the dots one-by-one. If needed, slice off the gameboard so it ends at 20, 30 or 40, close to that student's upper counting limit.

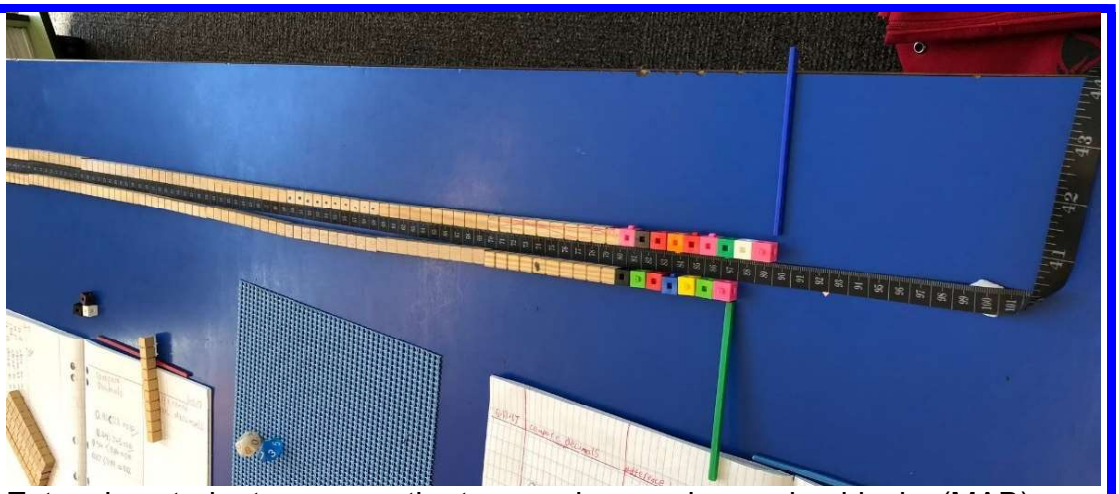
A printable snakes and ladders gameboard is in this unit's folder.

Extension 1 – Partition 100: Figure out how much more you would need to reach 100 from your current position. For example, if you are on 54, how many more spots to go until you reach 100? Well, you could add 6 to get to 60. Then 4 more tens to get to 100. So, it is 46 to go.
Misconception alert: It is not 54 + 56, because that would get you to 110! Many students just use their 10 facts, without accounting for the ones creating an additional ten. For example, many students will believe that 73 + 37 makes 100, rather than 73 + 27.

The way to address this misconception is to show students its flaw using the place value blocks (MAB) along the measuring tape. Make 7 tens and 3 ones. Then add another 2 more tens blocks and 7 ones. You are at 100! When you add 3 tens and 7 ones to 73, you cannot actually fit it within the 100, it actually makes 110!

This is essentially a jump strategy and can be recorded like this by extension students, using a second column of their grid book (while playing the regular version of the game and recording that on the other half of their page):





Extension students can use the tens and ones place value blocks (MAB) from their current position, placing these along the measuring tape for assistance to work out 'how many more to make 100?'

Alternatively, try it mentally by getting to the next ten by adding ones (use your 10 facts), then use the 10cm counting sticks to figure out how many more tens there are to go to reach the full 100.

Extension 2: Use the measuring tape as a decimal number line. 1m is the target or whole. The tens sticks are tenths (one out of ten parts) and students round to the nearest tenth each turn.

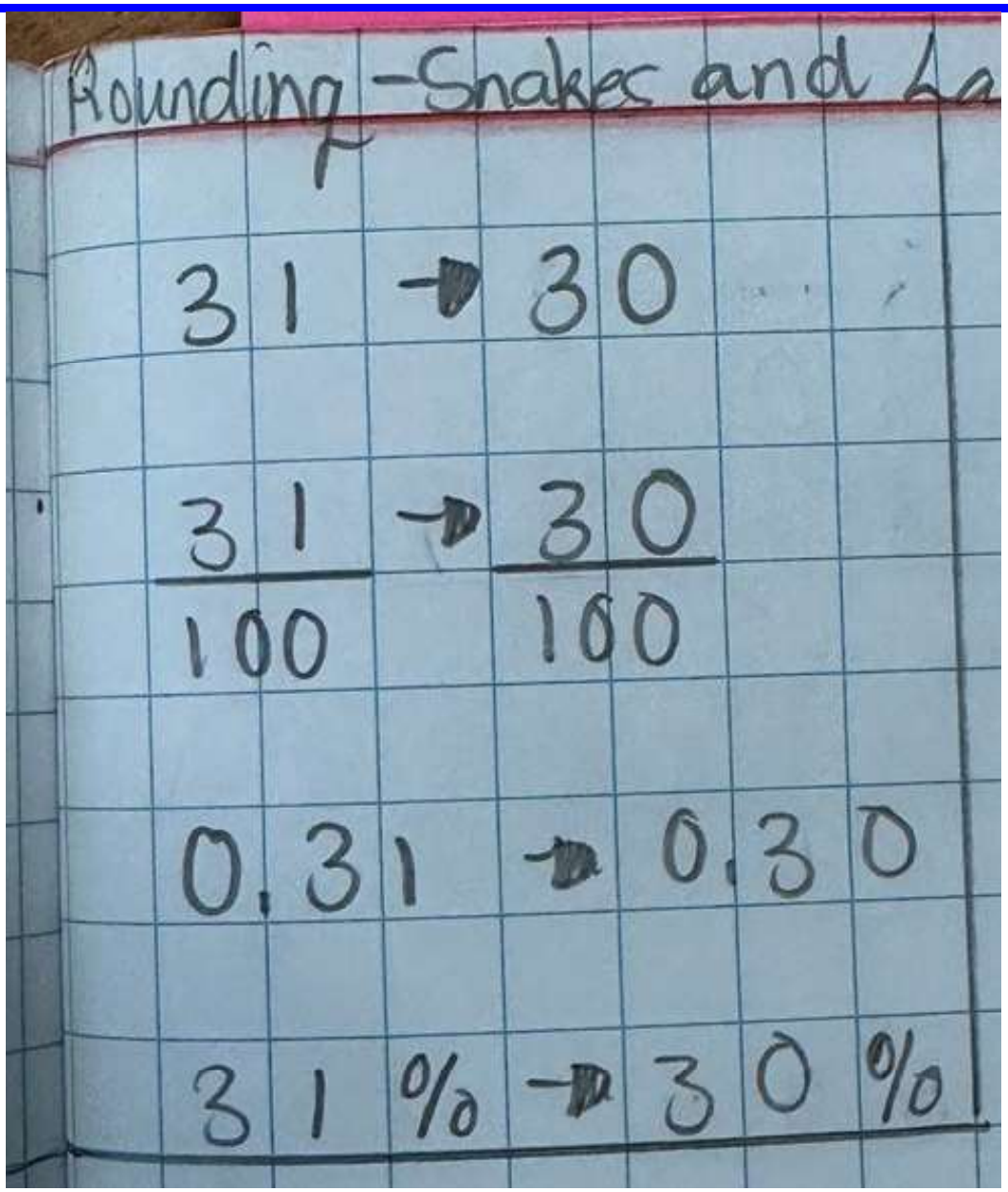
Extension modelling – continuation of the fishbowl while other students begin work: How many centimetres are in one metre? So, each centimetre is one out of 100 parts or one hundred*th*. Each 10cm is one out of 10 parts of the whole metre – each 10cm is one ten*th* of the way. This is very clear with the sticks set up at each ten mark, because students can see that one ten is one out of ten parts of the way towards one metre, 2 tens is 2 out of 10 or two tenths of the way, and so on.

As you play, record where you land as a decimal – a part of one whole metre. For example, if you landed on 76, it would be 0.76m (0 whole metres and 76 parts of one metre), or 76/100 (76 out of 100 centimetres). You can see from the counting sticks placed at each tenth, 76/100 is closest to 0.80m or 8/10m (8 out of 10 parts of one metre) or 80/100m (80 out of 100 parts of one metre).

Recording would look like this, but can also show the fraction notation:

0.30m ⟸ 0.34m 30/100 ⟸ 34/100

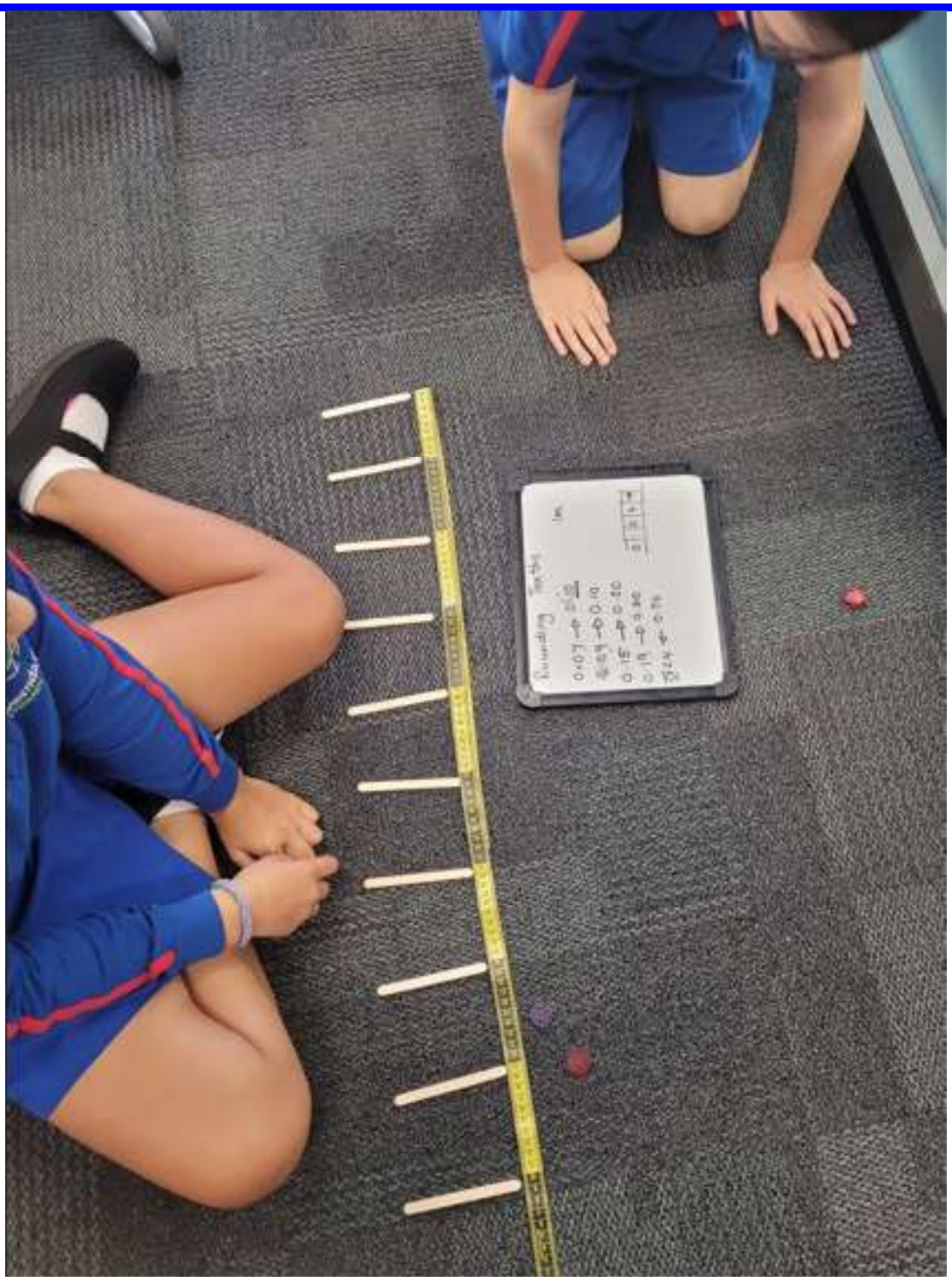
3/10 ⟸ 3/10 + 4/100



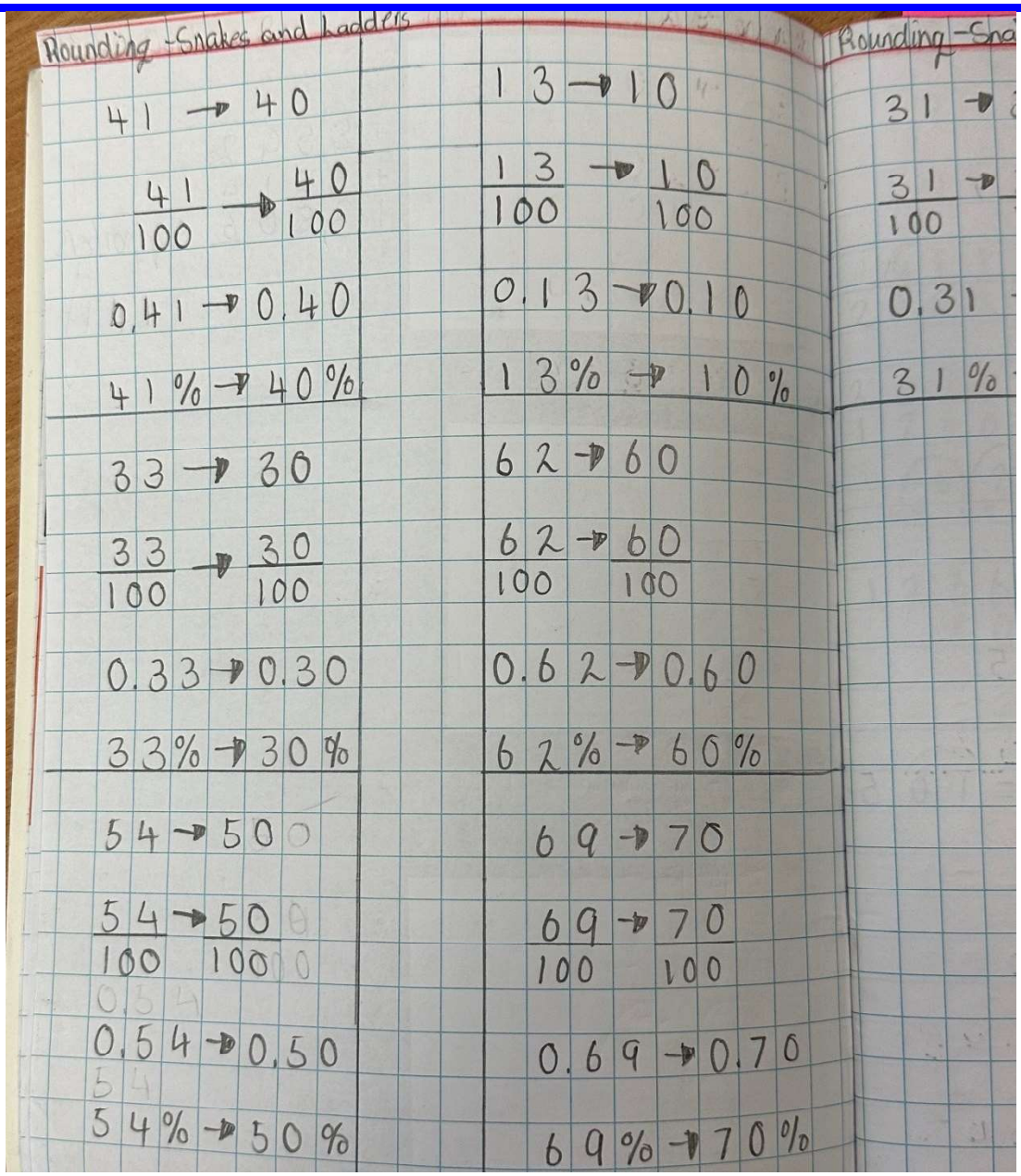
Questioning:

- What is worth more, the tenths or the hundredths? Is this the same as our non-decimal place value system, or reversed? Why? Because ten*th* means 1 out of 10 parts of the whole, whereas hundred*th* means 1 out of 100 parts of the whole.

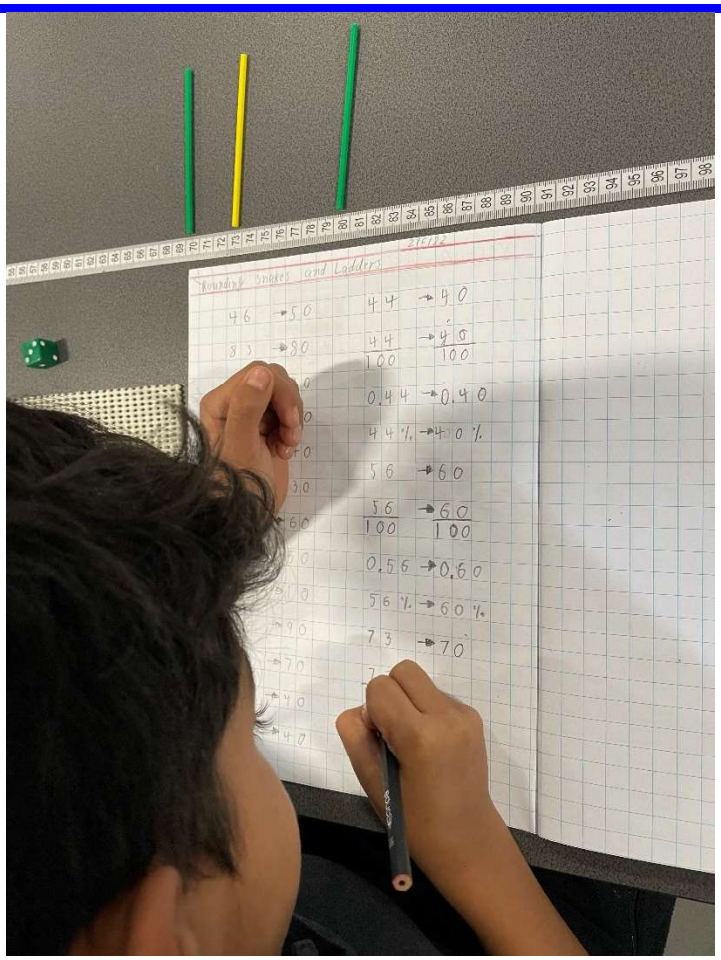
- Where do you think 0.50 is on the measuring tape (5 tenths, 0 hundredths)? Is 0.5 (5 tenths, no hundredths) the same or different to 0.50? Where is 0.05 (0 tenths, 5 hundredths)? Which position is better, if you are racing to one whole metre, 0.5m or 0.05m?

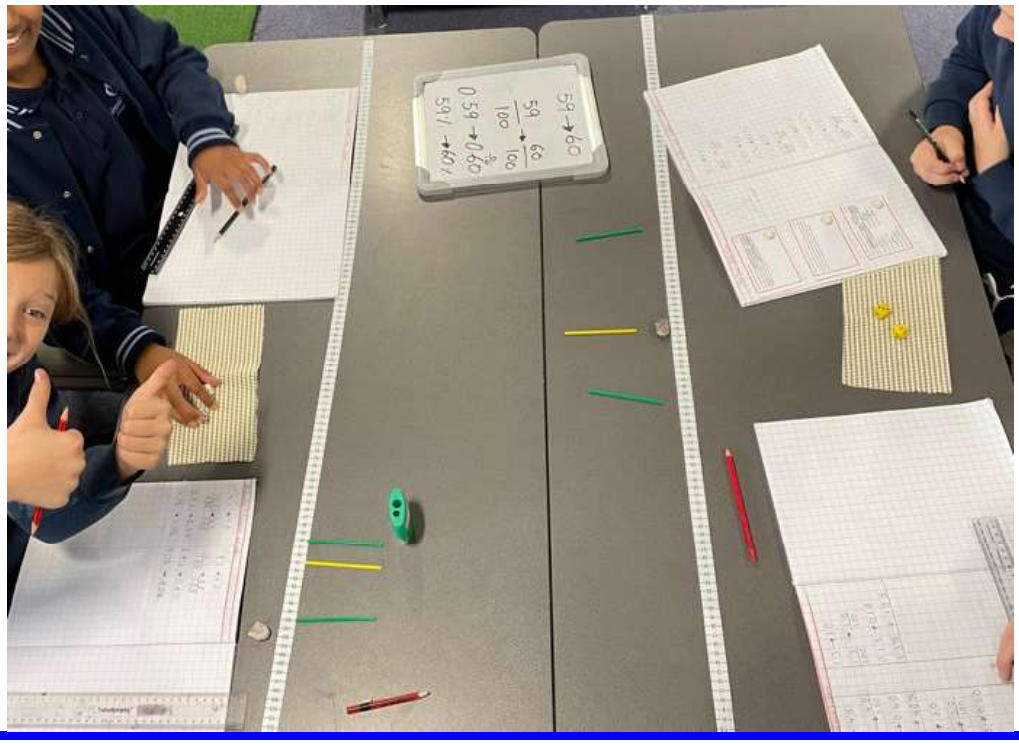


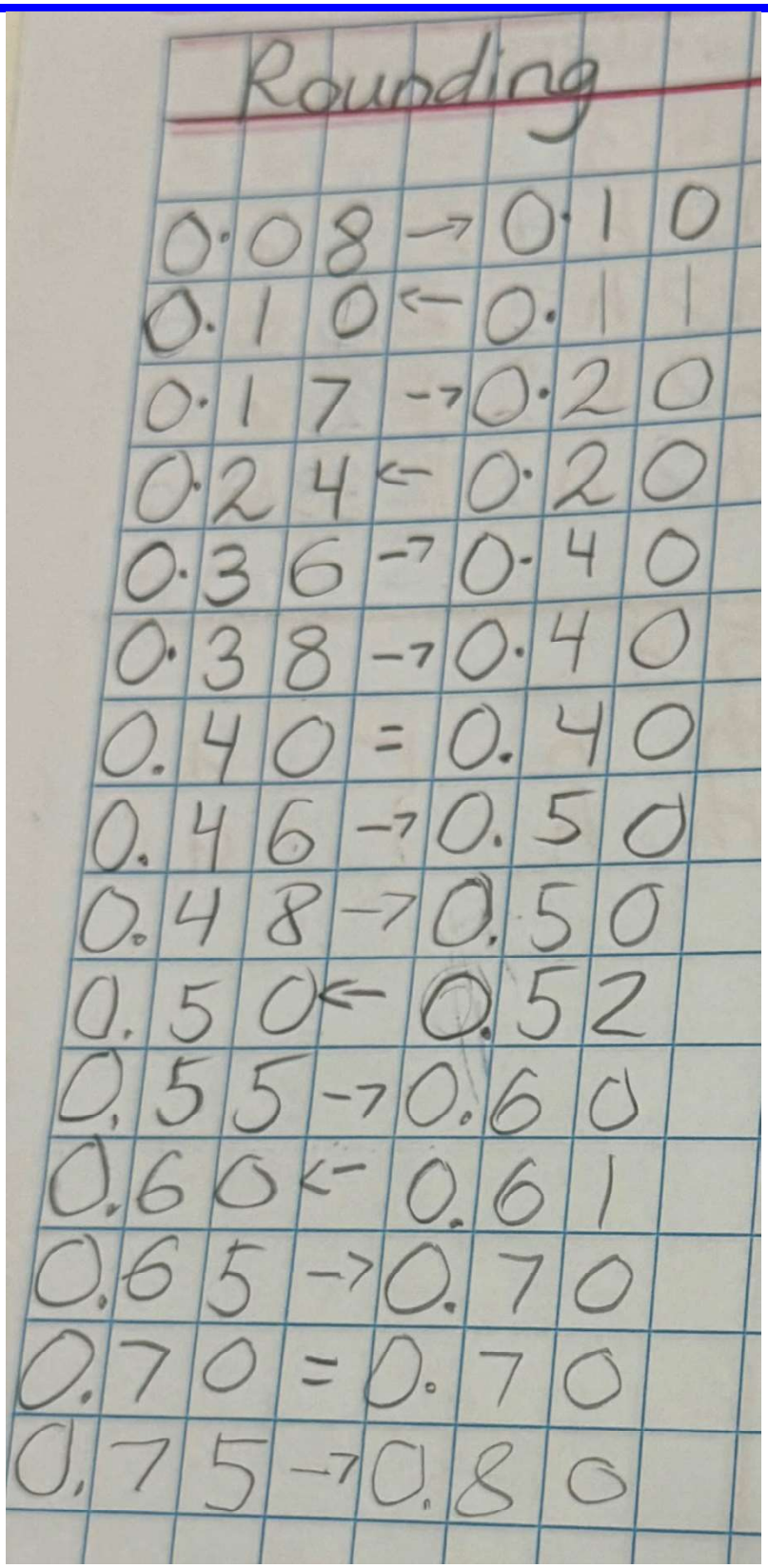
Mernda Park PS – decimal extension version



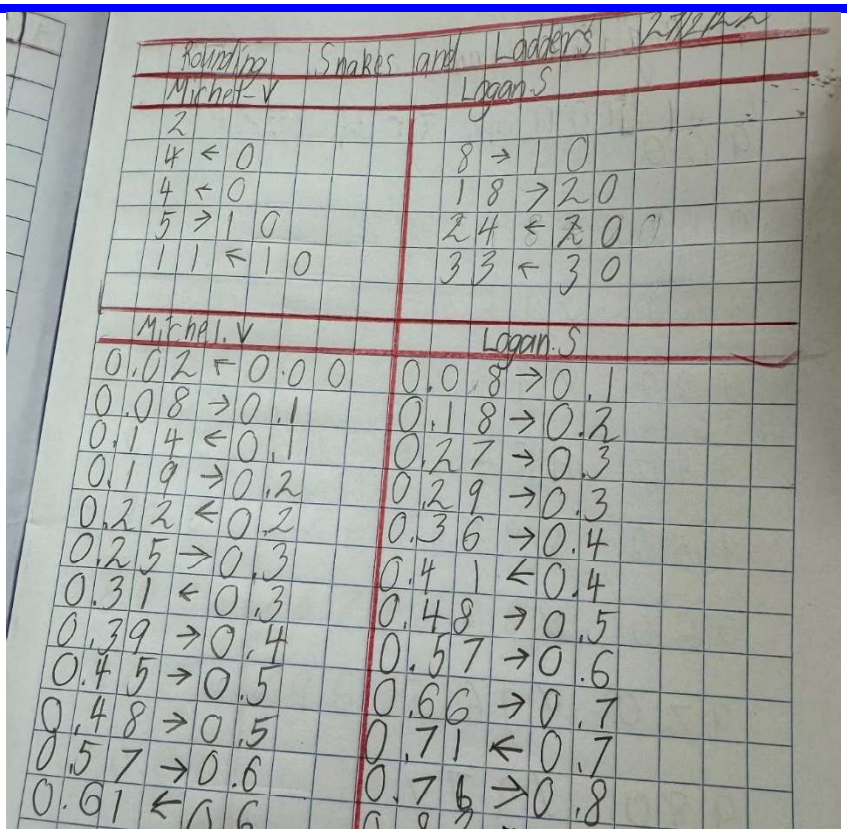
Student work sample from Chirnside Park PS



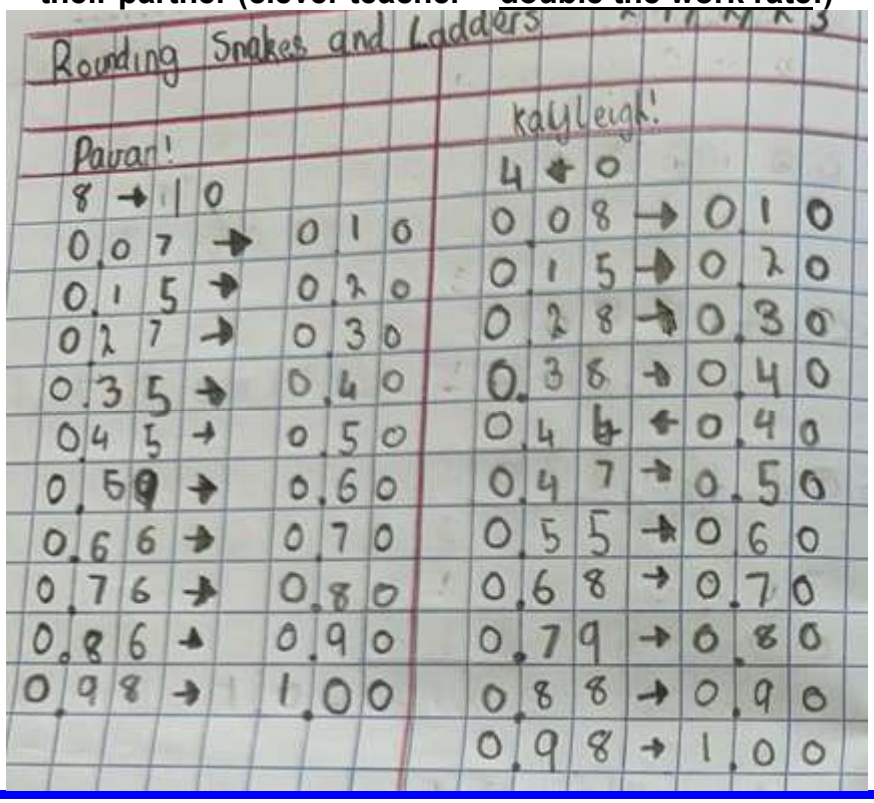




Student work sample



Student work sample with students recording for both themselves and their partner (clever teacher – <u>double the work rate</u>!)



Extension 3: Instead of placing the sticks at every tenth, place them at every fifth by splitting the 100cm or one whole metre into five equal parts. Provide students with coins ($1 and other coins) to work this out, sharing $1 between 5 friends (mini figurines). Each friend receives 20^{c}, so the sticks go at 20, 40, 60, 80 and 100. Now roll a 20-sided die and round to the nearest fifth. This is also the percentage, 1/5 = 20% or 0.20 or 20/100 or 2/10, because percentages are out of 100. So 1/5 is just splitting 100 into 5 equal parts. 2/5 is 40% or 40cm or 0.40, 3/5 is 0.60 or 60%, and so on.

Students can then invent new versions of the game themselves, changing the fractions they are rounding to each game. Set up the new number line, which involves a fraction to decimal and percentage conversion. To work this out, think about an even share of 100 cents or $1.
For example, for rounding to the nearest quarter, set up the sticks by thinking about 100 cents or $1 shared between 4 friends. Each friend would receive 25 cents, so one rounding stick is placed at 25, another at 50, another at 75, and the final at 100.

Provide students with coins and mini figurines to work this out.

If you are rounding to the nearest third, split the $1 between 3 friends. Use plain counters to represent single cent coins.

Finally, before playing the new rounding game, choose dice (or make a post-it note cup with numbers in it to pull out) that make each version of the game progress at a fair pace (not too fast and not too slow). The choice of dice, or which numbers to put in the post-it note cup, will depend on the location of the sticks, which show the fraction to decimal to percentage conversion.