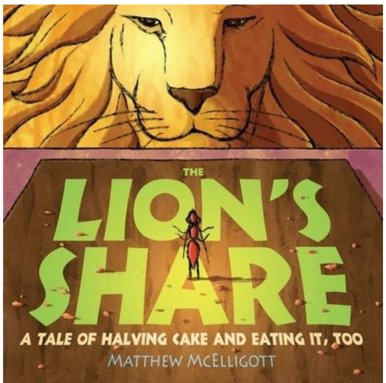
Numeracy Picture Book Library

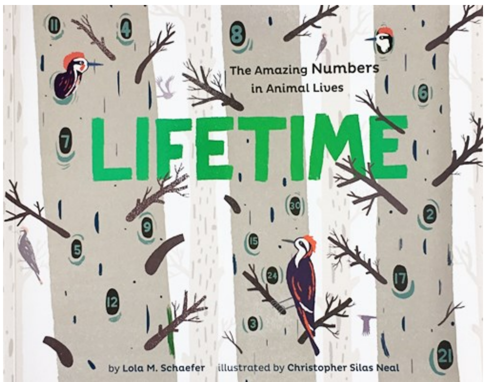
Bringing Literacy and Numeracy Together!

<u>40 hard copy numeracy picture books chosen by Australian teachers and maths leaders.</u>

All books packed into sections (place value; addition; subtraction; multiplication; division; fractions; measurement and geometry; statistics and probability), making it easy for teams to use literature to launch hands-on maths lessons.

<u>Easy-to-use catalogue that organises all books by year level and specific numeracy concept.</u>





Selectively Chosen Numeracy Picture Books with Hands-on Lessons linked to the <u>new WA Curriculum</u>

Catalogue that organises all books by their best-suited year level and concept

150 Hands-on lesson plans inspired by each storyline, with photographs of teacher modelling, student work samples, questioning tips, as well as planned support and extension options for each lesson

40 Books with 150 Lessons for $1499 (ex. GST) free delivery!

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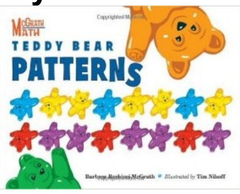
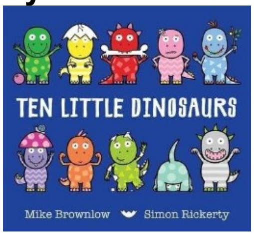
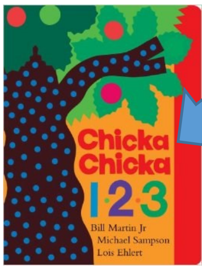
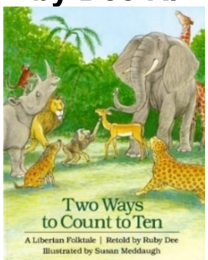
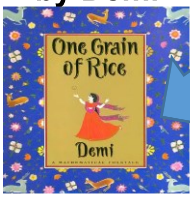
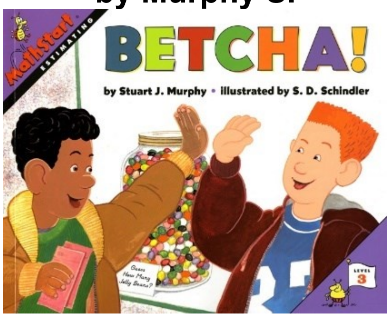
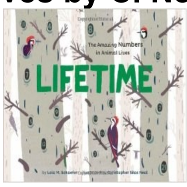
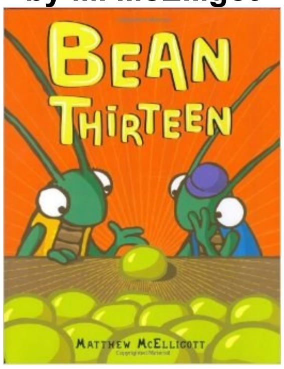
SHORT SAMPLE OF THE ORGANISED CATALOGUE

Place Value Section (short sample only – the Place Value catalogue in the complete pack contains many more books than those listed here):

<table>
<tr>
<td>Teddy Bear Patterns
by McGrath B.

Kindy and Pre-Primary: Patterns and Relationships: Copy, continue and create repeating patterns</td>
<td>Ten Little Dinosaurs
by Brownlow M.

Pre-Primary – Understanding number: Counting backwards by ones</td>
<td>Chicka Chicka 1 2 3
Martin B.

Year 2 – Say, read, write and order numbers up to 120</td>
</tr>
<tr>
<td>Two Ways to Count to 10
by Dee R.

Year 2 – Understanding number: Skip-count by two, three, five and ten</td>
<td>Sir Cumference and All the King's Tens
by Neuschwander C.

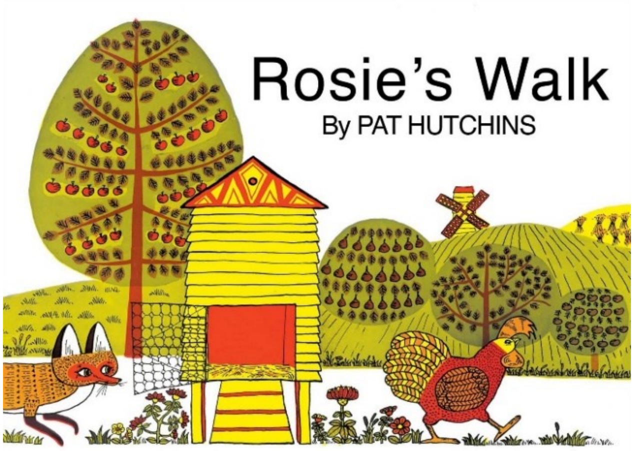
Year 2 – Understanding number: Partition using place values up to 1020</td>
<td>One Grain of Rice
by Demi

Year 4 – Understanding number: Large doubling and estimation</td>
</tr>
<tr>
<td>Betcha!
by Murphy S.

Year 4 – Calculating with number: Additive estimation strategies</td>
<td>Lifetime: Amazing Numbers in Animal Lives by C. Neal

Year 5 – Place values to the billions
Year 6 – Two-dimensional space and structures: Convert between units of length</td>
<td>Bean Thirteen
by M. McElligot

Year 6 – Prime and composite numbers</td>
</tr>
</table>

Teachers click on the front covers and are taken directly to hands-on lessons prepared for that story. Titles and lessons are organised for each year level, concept, and specific skills and strategies.

LIST OF INCLUDED CATALOGUES IN THE 40 NUMERACY LIBRARY PACK:

PLACE VALUE, ADDITION, SUBTRACTION, MULTIPLICATION, DIVISION, FRACTIONS, MEASUREMENT AND GEOMETRY, STATISTICS AND PROBABILITY.

Rosie's Walk
Hutchins P.

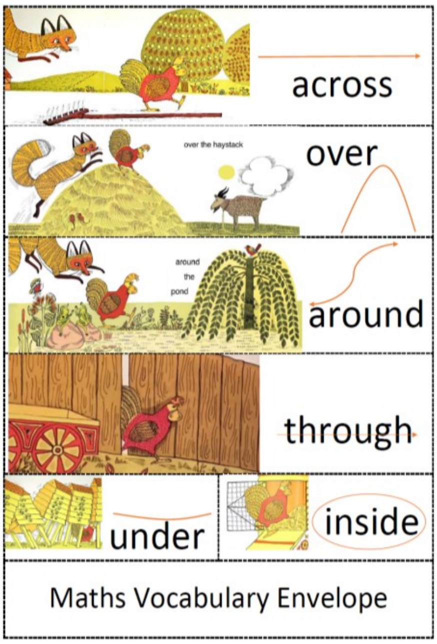


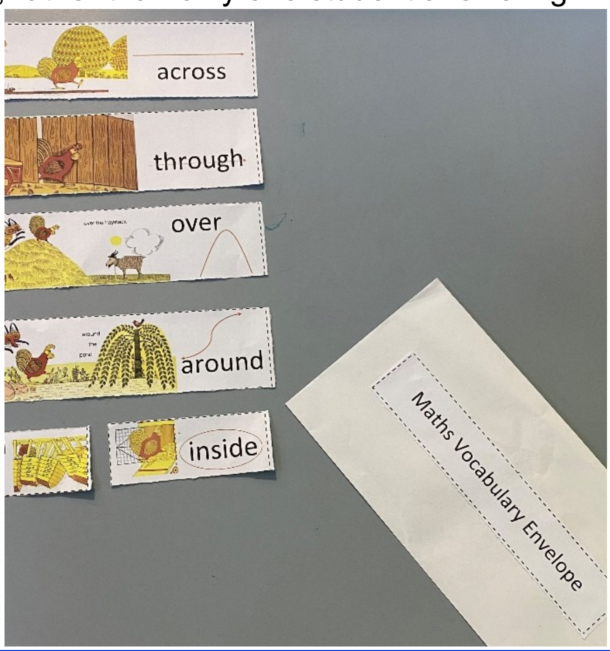
Storyline: A hen goes for a walk, going across, around, through and under obstacles, unaware that a fox is pursuing her and constantly being thwarted by her movements.

Best features: Great illustrations and classic story incorporating the foundations of positional language.

Pre-Primary – **Two-dimensional space and structures:** Show and describe position and movement in familiar locations.

WHAT DID ROSIE DO?	
Read in full. As you read each page, students pick the relevant vocabulary card for that page of the story from their vocabulary envelope, holding this up at your cue.	Students sit around a whole-class circle. Place something large in the middle of the circle, such as a cardboard box. Invite one student to approach, pretending they are Rosie the hen, and make a movement. For example, the student could crawl through the box, walk around the box, step over the box, or sit under the box (placing it on top of their head). The other students, watching around the circle, pick a positional movement card from their vocabulary envelopes to describe the movement that was made. Print these from the *Templates* folder (*Rosie's Walk vocabulary envelopes*). Slice and place in maths vocabulary envelopes, so that students can pick the correct one to describe each movement. This can be likened to a gameshow to engage students, and ensures all students think and receive immediate feedback each time, rather than only one student answering:





	Extension: Challenge extension students to provide three oral descriptions for each movement. For example, if the student showing the movements puts the box on their head, they could say 'under' but also 'below,' 'beneath' and 'underneath.'

Recommended vocabulary list to focus on building throughout a unit on positional language (create matching photographs of students acting out each set):

up down

over on top of above

under beneath below

across through in between

around turn

in into inside out outside

on off

next to beside alongside adjacent

side-by-side face-to-face back-to-back

backwards forwards sideways

left right

near far close close by

If there is a class set of iPads available in the school (one per pair), the teacher could read out each word from this list, with groups of three acting it out. For example, photograph an example of 'face-to-face' with two students facing one another and the third student taking the photo. Print a few of these photographs and place them beside the words on your class numeracy wall.

Pre-Primary – Two-dimensional space and structures: Show and describe position and movement in familiar locations.

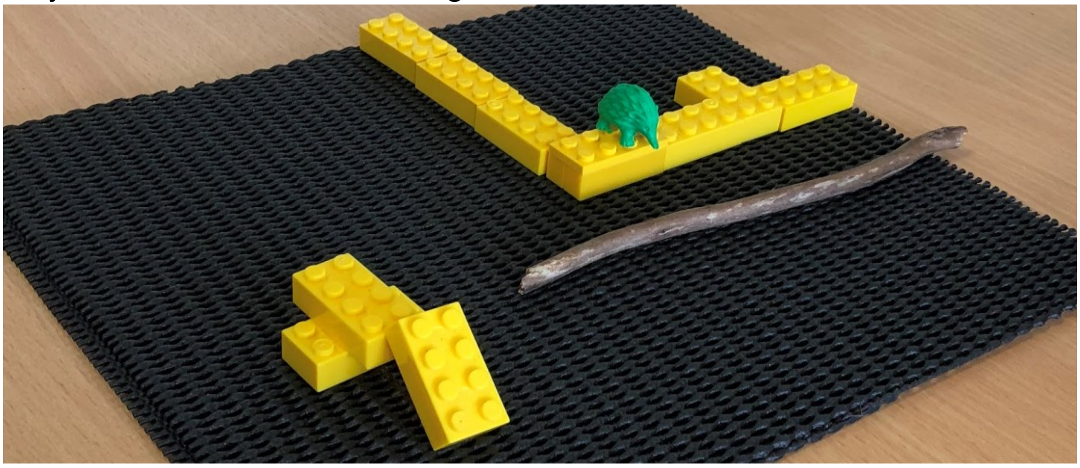
PLAYGROUND OBSTACLE COURSE AND MINI OBSTACLE COURSES

Read the story in full. At each page, pause and add the positional word (for example, 'over') to class a anchor chart, using the printable templates of Rosie the hen. For example, draw her under the beehives, over the haystack, and so on. Printable templates of Rosie for anchor charts are on the following page. Allow students who love art to approach the anchor chart and do the quick sketch of the objects she is moving around.

As students travel through the play equipment or an obstacle course set up with P.E. equipment, they describe each movement to a partner who is following them and repeats it. Use the language of the story to model words such as 'across,' 'under,' 'through,' 'over', 'inside' and so on. For example, "I am going through the tunnel. I am moving down the slide. I am hiding under the platform. I am between the cones."

As a whole-class warm-up, student A could place themselves somewhere on the playground and all the other students could raise their hand to try to describe student A's position, using positional language: "Alistair is in between the poles." Then students travel through the playground or obstacle course in pairs, with the first student describing the movement and the second orally repeating the language as they follow. At first, arrange students into mixed-ability pairs, with extension students initiating the positional language and a support student following to repeat it.

Students could also make a mini obstacle course on a grip mat using Lego or maths materials. Students orally describe to a partner how they are getting their character from the start to the end of the obstacle course, as they move their character through it.

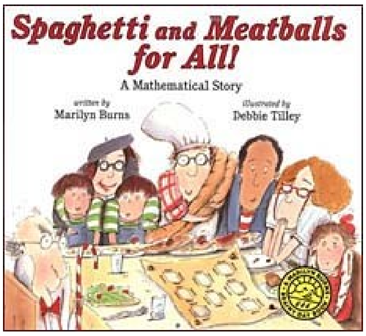


"My echidna is going over the wall and jumping down to the ground."

"My echidna (yellow) is beside yours," or, "On the right of yours." "Our echidnas are side-by-side."

"My echidna is behind yours." "My echidna is in front of yours."

Spaghetti and Meatballs for All!



Storyline: Mr. and Mrs. Comfort organise a family reunion for 32 guests. However, as people arrive, their guests start to change the carefully planned table arrangements.

Best features: Great illustrations of table arrangements and real-life context for both multiplication and division relating to the recipe and guest configurations within the story.

Year 4 – Understanding number: Represent and explain the relationship between multiplication and division, using arrays and equations.

DINNER PARTY!

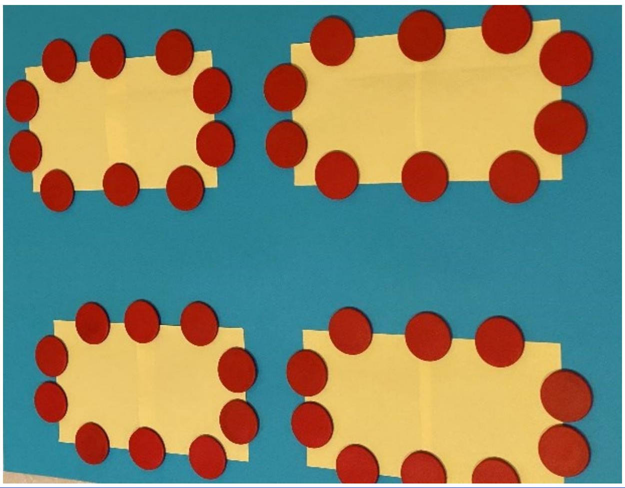
As you read: Pause at the pages listed within the *detailed reading instructions* (see right) to allow students to create each new seating arrangement using counters and post-it notes as the story progresses.

Students create the story using materials on their desks as it unfolds.

Materials: Post-it notes or 16 small squares of paper, representing the tables in the story. Students could create these as part of a fractions warm-up, folding two A4 pages into eighths as a class. Open the paper and discuss each fraction, before refolding it into a smaller fraction each time. 32 counters represent the people around the tables.

Modelling and questioning: Model how to use the square pieces of paper and counters to act out guests sitting around a table, as shown below.

Detailed reading instructions: Stop at the page that starts with "Mrs. Comfort found a folding chair." Ask students to use their materials to figure out how she could seat 32 people around the tables. Then continue reading to see how Mrs. Comfort chose to do it: 8 tables of 4 people.
Stop at the next page after reading: "There's plenty of room and plenty of garlic bread." Instruct students to push 2 of their tables together like what has just happened in the story. Will 32 people still fit?
Continue this process, stopping and asking students to model the changes (after the guests push tables together on each new page), pausing to investigate whether or not the new layout will still fit all 32 guests.



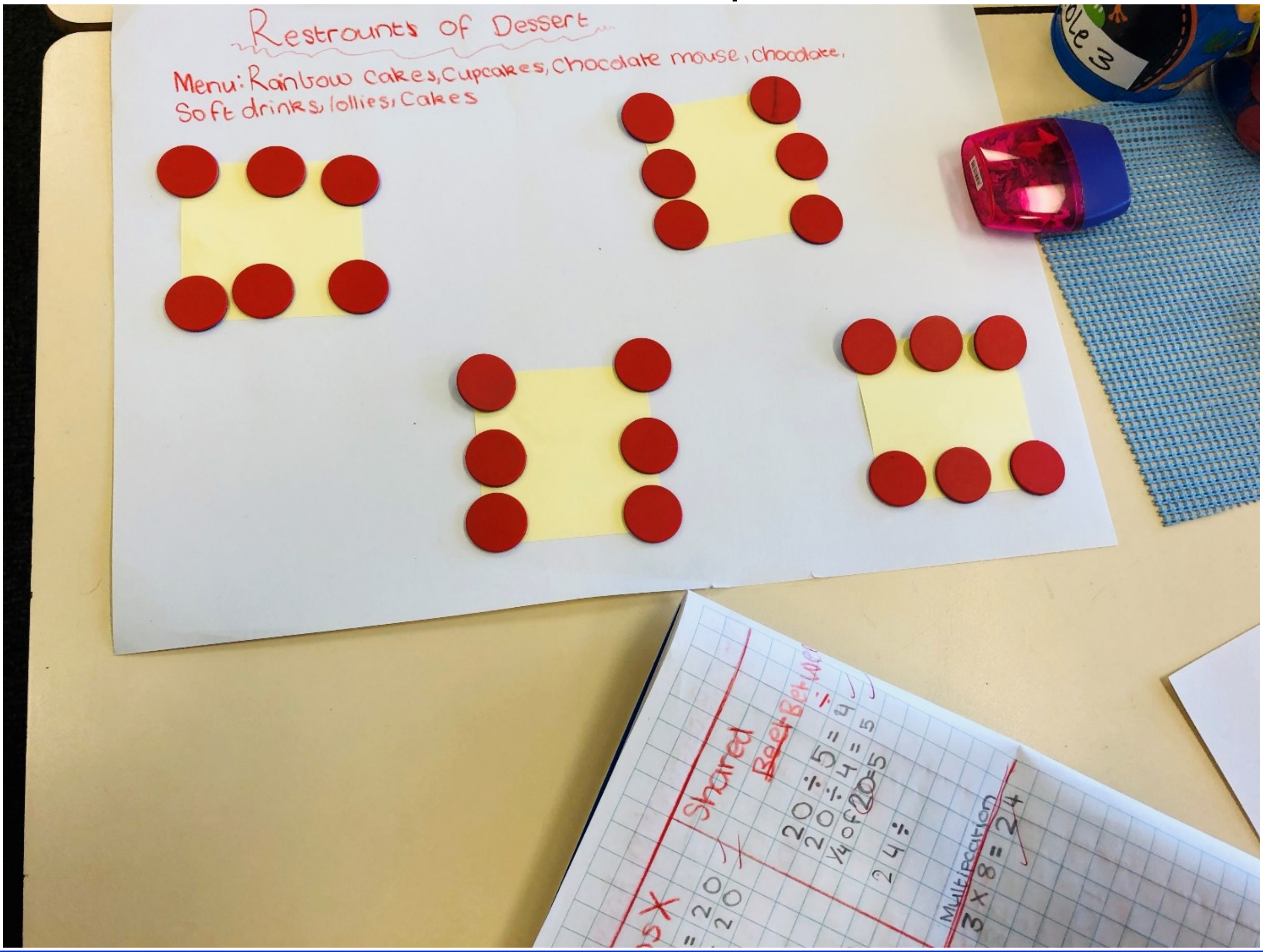
Extension during whole-class modelling: Use 64 guests. What changes about your results? If the class figured out 32 guests shared between 4 tables is 8, what is 64 guests shared between 4 tables? What about 128 guests shared between 4 tables? How can you use a halving strategy to solve divisions by 2, 4, 8 and 16?

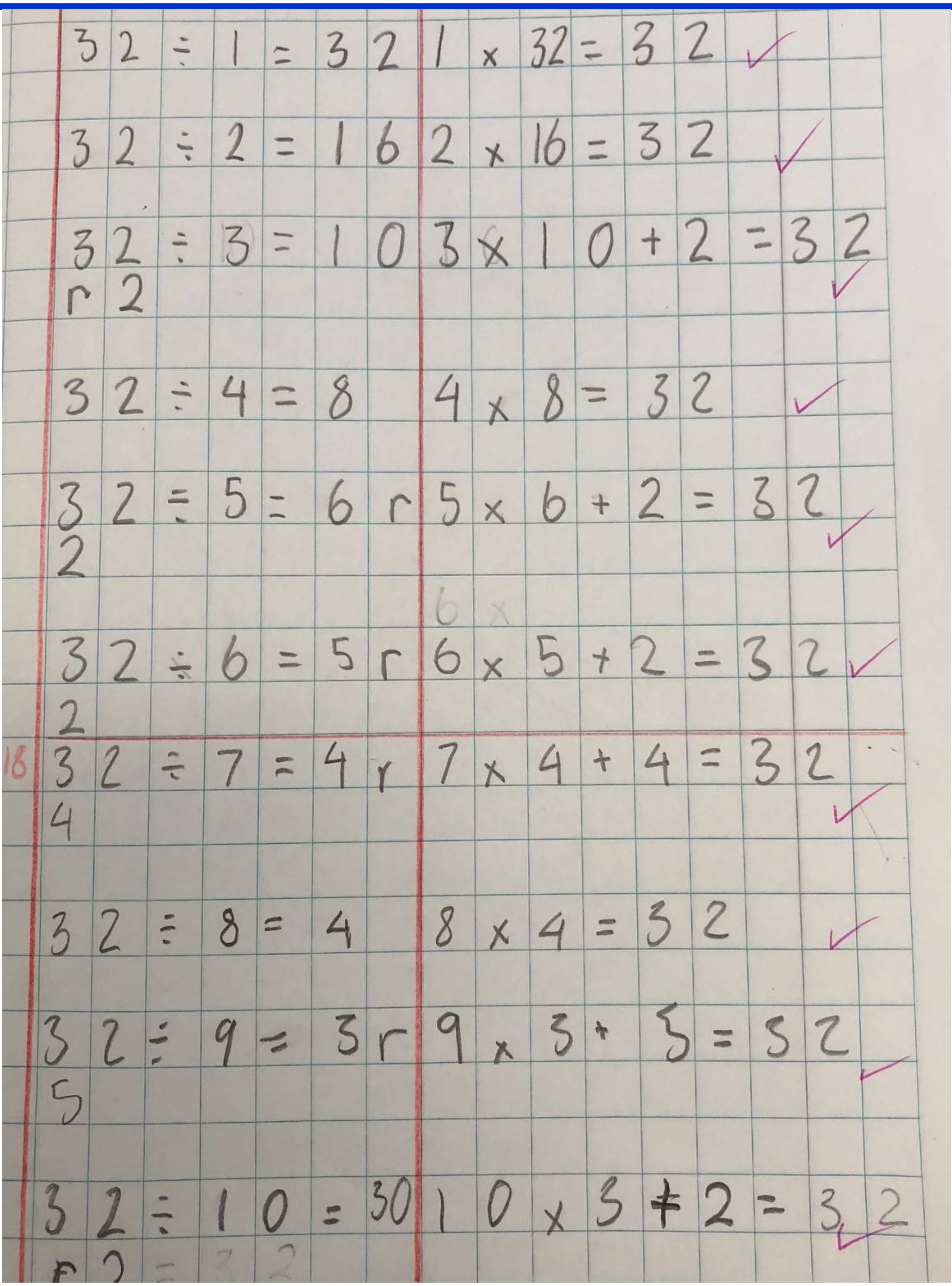
After the whole-class reading and guided investigation, students create their own division dinner party. Provide students with an A3 page and three minutes to brainstorm their dream restaurant's name and a three-course menu at the top of their poster page.

Extension and support: During the menu brainstorm time, allocate a number of guests to each student – this is the number of people who will be dining at their restaurant that night. Allocate the total based on each student's ability. For example, extension students may have 84, 64 or 56 guests, mid-range students may have 36 or 40 guests, and support students may have 12, 18 or 24 guests.

Now ask students to figure out all the ways they could arrange the tables to seat their guests. Emphasise that all the tables must be equal at their restaurant, to ensure each receives the same amount of food during their set menu dinner. Division is about equal shares: "The share must be fair!" The most supportive approach is to model for students to work up sequentially, adding one table at a time. For example, start with one long table, and record that 36 guests shared onto 1 table makes 36, 36 ÷ 1 = 36. Also record the matching multiplication sentence, 1 table of 36 guests makes 36, 1 x 36 = 36. Record using two columns (division and multiplication), as shown in the student work sample on the next page. Now share between 2 tables, then 3, then 4, and so on until you have 36 tables. If there are leftovers/remainders at any time, leave the unseated guests at the door, waiting for a table to become available.

Student work samples

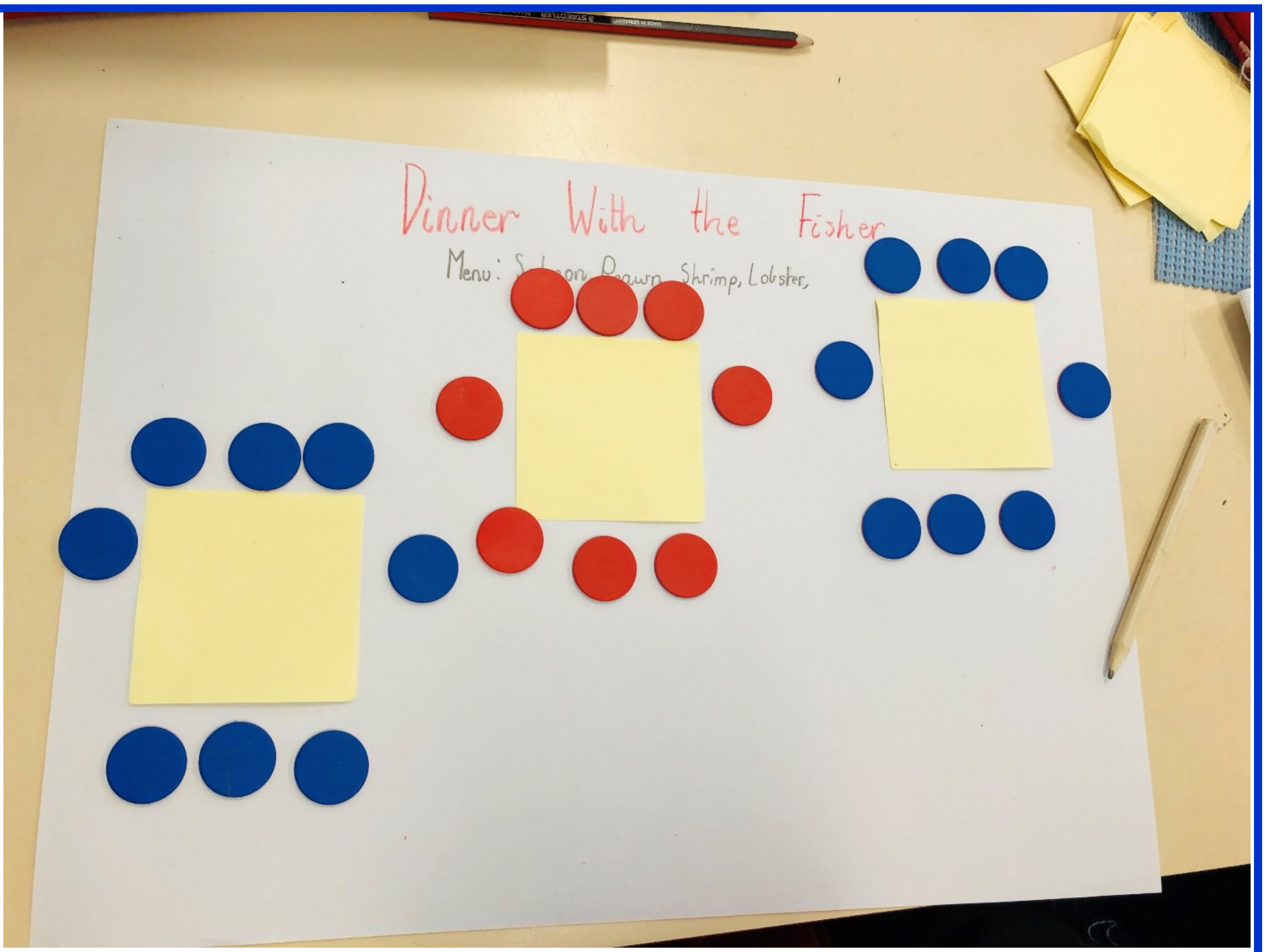




Division: "32 shared between 9 tables makes 3 guests on each, with 5 remainders."

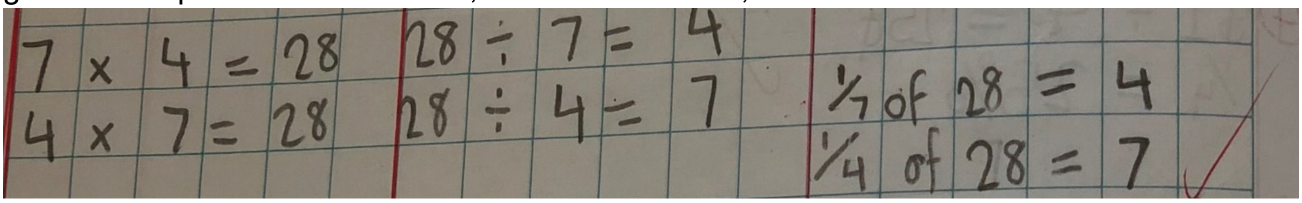
32 ÷ 9 = 3 r 5 9 x 3 + 5 = 32

Matching multiplication: "9 tables with 3 guests each makes 27, and 5 extra makes 32."



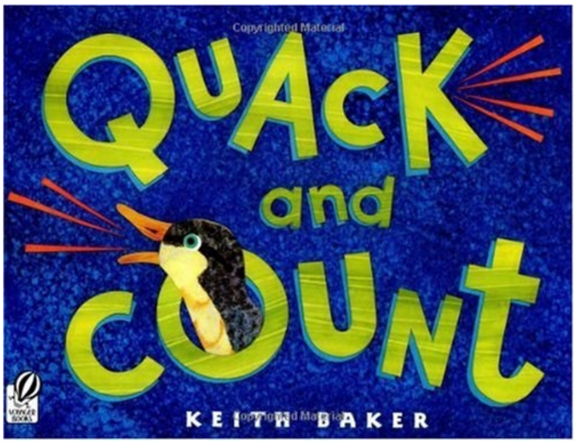
Connecting the language of multiplication and division:
Multiplication language: “3 tables with 8 on each makes 24,” 3 x 8 = 24
Division language: “24 shared between 3 tables makes 8 on each,” 24 ÷ 3 = 8

Extension: Also record the matching fraction for each arrangement. For example, for 36 shared between 2 = 18, this could also be written as ½ of 36 = 18, because ½ of the guests are on one table and half are on another, each table has 18 guests. Likewise, when the guests are split between 3 tables, it is 1/3 of 36 = 12, and so on.



1 out of 7 tables with 28 guests in total makes 4 guests on each, so 1/7 of 28 is 4
1/7 x 28 = 4
1 out of 4 tables with 28 guests in total makes 7 guests on each, so ¼ of 28 is 7
¼ x 28 = 7
I know ¼ is 25% because $1 or 100^{c} shared between 4 friends is 25^{c}, since percentages are always out of 100, so ¼ or 25% of 28 is 7, or 0.25 x 28 = 7
So, 50% of 28 is 14, and 75% or ¾ (3 out of 4 tables) of 28 is 21.

Quack and Count



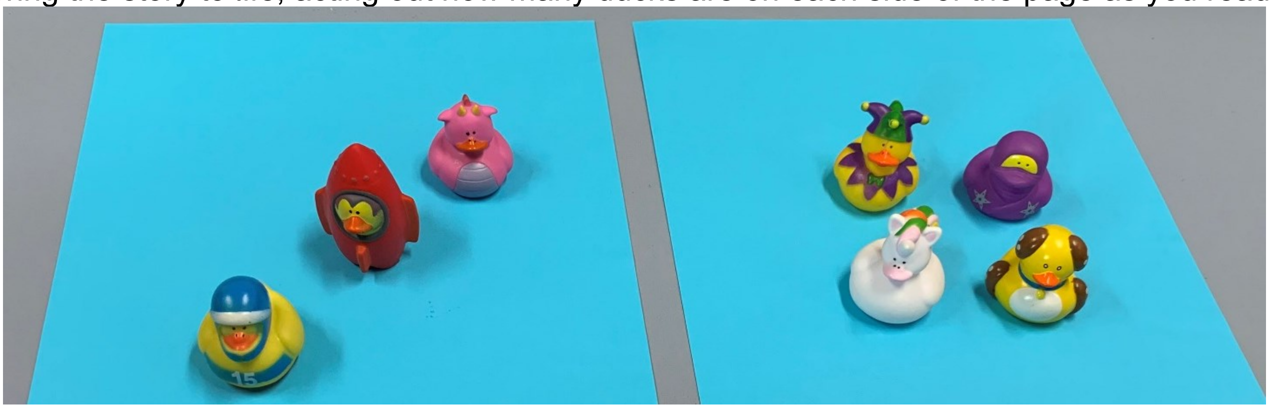
Storyline: Seven ducklings go about their day, and with each new activity some are on the right side of the page and some are on the left.

Best features: Clearly visible font explaining the addition/partition of the seven ducklings: *5 and 2 makes 7 ducklings.* Cute rhyming text.

Year 1 – Understanding number: Explore partitions of numbers with small collections, using part-part-whole relationships.

WHERE ARE MY 7 LITTLE DUCKLINGS?

While reading: Use two hoops or blue pieces of paper and rubber ducks or soft toys to bring the story to life, acting out how many ducks are on each side of the page as you read.



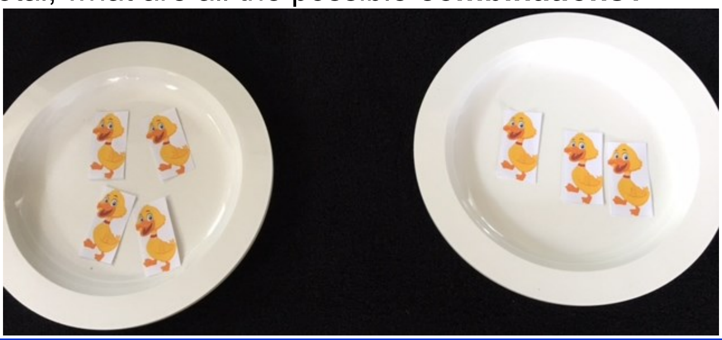
Student practice: Students use the printable ducklings and plates/blue kinder circles to investigate all the ways their own ducklings could swim between two ponds.

Materials: 2 blue kinder circles or 2 plates. *Duckling templates from page 3 and student recording template on page 4.* Model like so:

Left pond	Right pond	Makes
5	2	7
2	5	7
3	4	7
4	3	7

Alternatively, students could record using the _and_makes_ templates:
5 and 2 makes 7   5 + 2 = 7

Modelling and questioning: Imagine you are the mummy/daddy duck. These circles are your two ponds. One day, you wake up and your 7 ducklings are all out of the nest. Some ducks are swimming on the left pond and some on the right. If you have 7 in total, what are all the possible **combinations?**

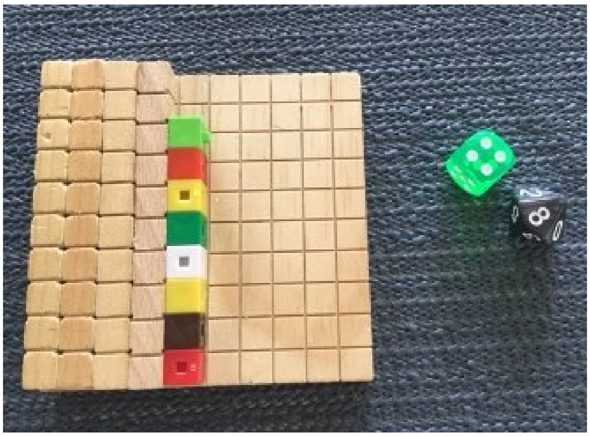


Support: Start with 5 ducks, working out all the ways to make 5, then add a duck to work on 6, and so on. Record using drawings (showing ducks as dots), rather than digits. Emphasise conservation and the commutative property by picking up the bowls and switching their places: "Are there still 5 ducklings?"

Extension 1: Use 3 or 4 ponds, rather than 2, therefore partitioning numbers into 3 or 4 parts and brainstorming many more combinations for each total.
Partition teen numbers, for example, investigate all the ways to make 11-19 ducklings.
Where possible, record some equal groups sentences when all plates have the same amount. For example, 3 ponds with 6 ducks each makes 18 altogether, 3 x 6 = 18.

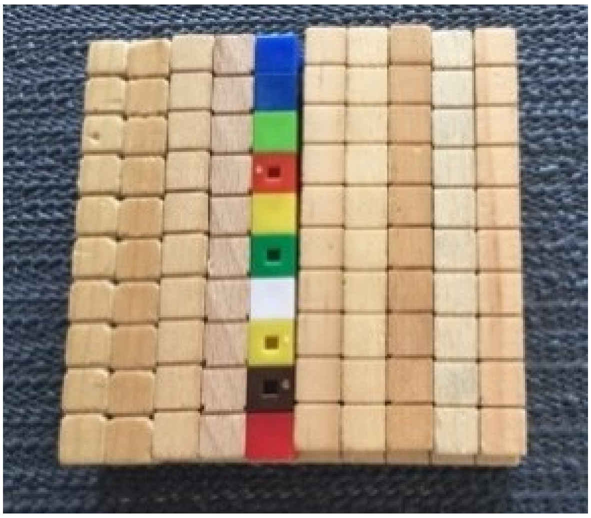
Extension 2: Create 100 'ducklings' using tens and ones blocks with a like-ability partner on top of a hundreds block.

Student A: Rolls 2 dice, one representing tens and another representing ones. "I have 4 tens and 8 ones, I have 48 ducklings!"



Record: 48 + ■ = 100

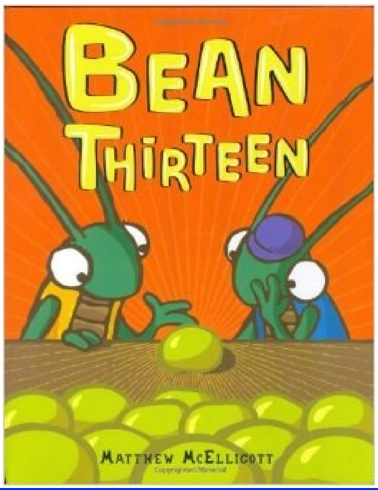
Student B: Investigate how many more are needed to make 100 ducklings altogether. Try this in your head at first, then by filling the remaining space on top of the hundreds block with tens and ones blocks:



Record: 48 + 52 = 100

Misconception alert: 48 + 62 = 100 because students do not account for the ones making another ten. By building the 100 ducks on top of a hundred block, students see this.

Bean Thirteen



Storyline: Ralph and Flora collect beans for dinner, but since they have 13 beans, no matter what number of guests they invite, they just cannot seem to share the meal equally to avoid unfair amounts or leftovers.

Best features: Engaging illustrations of a range of different arrays, showing the beans and remainders. Amusing characters. Fantastic use of colour on all pages.

<u>**Year 2**</u> **– Understanding number:** Explore multiplication and division using repeated addition, equal grouping and arrays.

THE BEAN PARTY

Read in full. Emphasise the page with 4 guests (Ralph, Flora, April and Joe) with the beans set up in a perfect array – apart from the one leftover. Use this page as a model for how students will be setting up their divisions of beans throughout this lesson.

Using animal characters, students share their beans (counters) with a changing number of guests. Extension year 2 students, and year 3 students, can connect this to the formal division algorithm (as shown on the next page), using the giant A3 division algorithm template.

Materials: Animal counters. Regular counters or anything similar to represent the beans.

Modelling and questioning: Choose how many beans you want to collect (keeping the total under 20 or 30 for most students). Start with two guests, just like Ralph and Flora. How many beans will each guest be able to eat? Add an extra guest and see how many they receive now. Record:

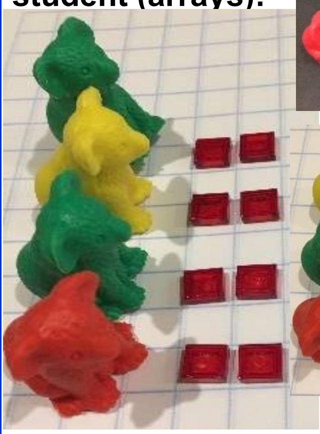
25 beans shared between 2 guests makes 12 each remainder 1 (use the *division sentence stem templates* for students with literacy barriers)

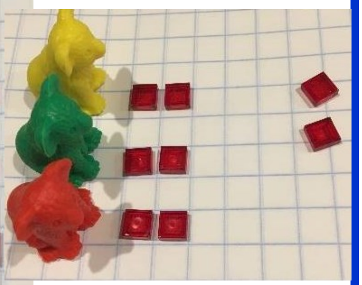
25 beans ÷ 2 guests = 12 r 1

See the teaching tips on the next page. Set up your beans like Ralph and Flora did in the book, in rows and columns. Maths calls this an <u>*arra*</u>*y*, because it is <u>*arra*</u>nged into neat rows, and looks like a square or rectangle.

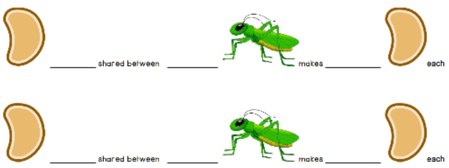
Year 2 support students:

Mid year 2 student (arrays):





Support: Start with 12 beans (or any other 'very' composite number such as 16 or 18). Use the *visual recording template*:

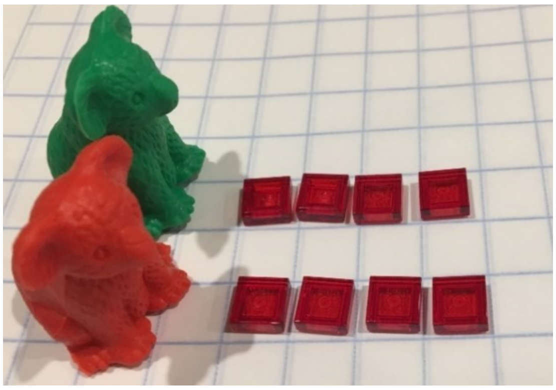


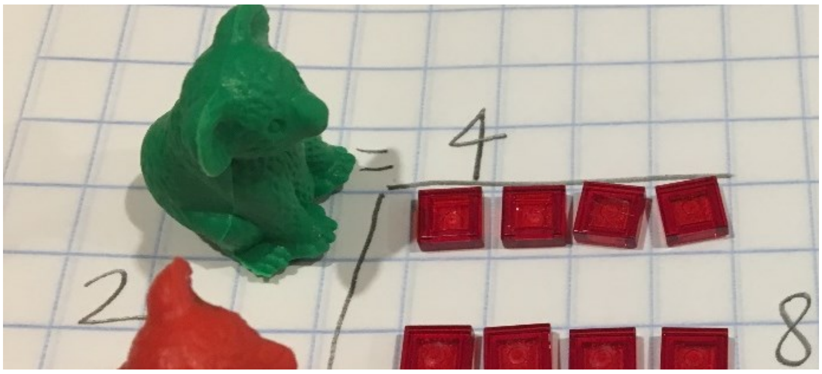
Extension: Can you find other numbers that always create remainders, no matter how many guests are involved? These are called 'prime'. How many prime numbers can you find? What do all the prime numbers have in common?

Teaching tips to make sense of the division algorithm:

Extension student work sample using the giant division algorithm mat, characters and cash notes to share $100 between 4 mates.

When students set up division in an array, as below, the division algorithm is virtually identical:

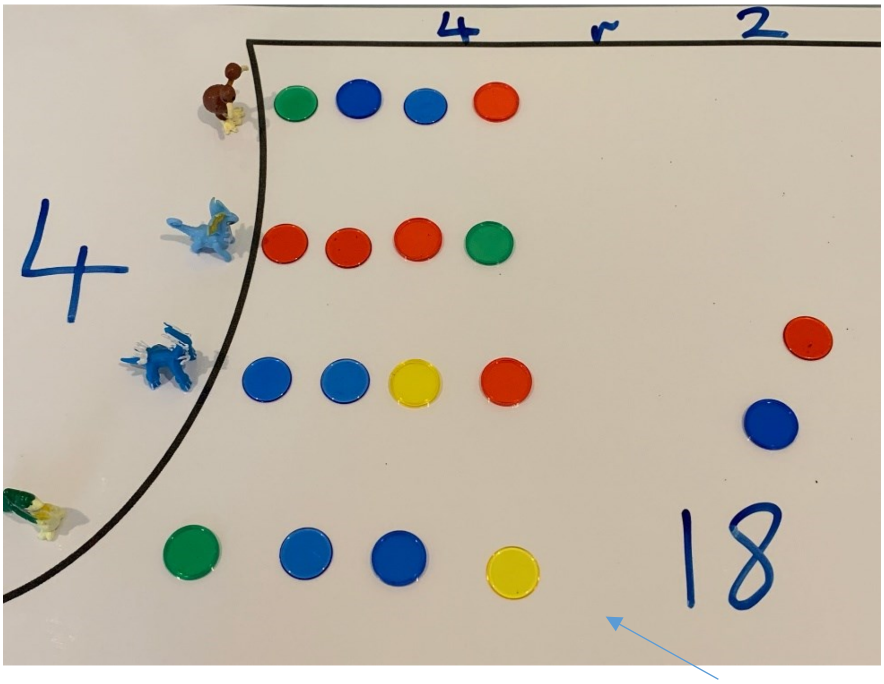




Under the algorithm, place the total that you are sharing (the starting number).

The figurines are placed along the left-hand side, showing how many guests you are sharing between. This could be described as how many people are knocking on the door to the house, eager to eat dinner. **Share one or a few to each guest at a time. It must be an equal share once you run out! The share must be fair!**

Your answer is how many things each person received. Write this above the line. Any remainders are pushed to the right-hand side and written above the line, beside the letter ‘r’.



The algorithm is read from bottom-to-top, right-to-left, as in: “**18** shared between **4** makes **4 with 2 remainders**.”

Use an A3 printout of a giant division algorithm (available in the *Templates* folder) to assist students to set up their materials within the algorithm and record in the correct places when drawing it in their books.

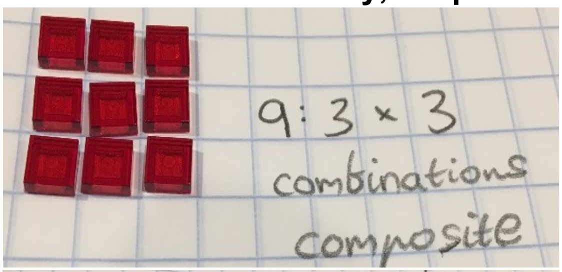
Year 6 – Understanding number: Explore, identify and represent square, prime and composite numbers in arrays and explain reasoning.

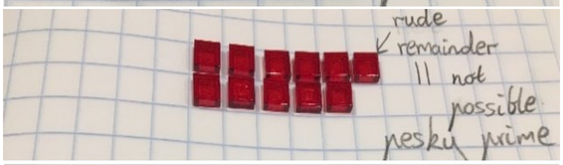
RUDE REMAINDERS, PESKY PRIMES AND COMBINATIONS COMPOSITES

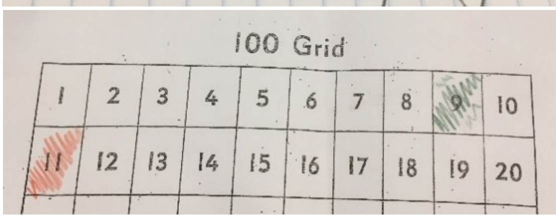
While reading: Heavily express and emphasise the following language in the story: **“one leftover” “that is odd” “so it’s fair” “extra bean”**

Students try to find other ‘unlucky’/prime numbers, like 13 in the story.
Modelling and questioning: Explain that maths calls these numbers **prime** because they just won't be shared between any more than 1 person or any less than the whole total (giving one to each person). Your challenge is now to find as many prime numbers as you can using counters as your beans. Model this with 13, sitting one student at a 'dining table' desk. Give the student the 13 beans one-by-one. "Yay, it worked." Now sit two students at the dining table. Share out the beans. Nope, one left. "Maths calls this a **remainder**, or we could call it a 'rude remainder' because there's one remaining and it would be rude to give it to Tom because Josh wouldn't get the same share." Hold up the extra bean and chorus: "RUDE REMAINDER!" Add one student at a time around the desk, all the way up to 13. So, we had remainders all the way up to the actual number we had to share (13), except for when we only had 1 person! Maths calls this number prime, or we can call it (chorus together): "PESKY PRIME NUMBER!" There are only two ways to share the number, like Optimus Prime from the *Transformers* movies, who only has two forms (a truck and a robot).
If there is another way to share the beans fairly, then it's not a prime, it's a: “COMBINATIONS **COMPOSITE**!” Print the vocabulary anchor chart two pages below, so that students can refer to this throughout the session.
Students can mark the numbers they find to be prime and composite on the 0-120 chart on the next page, aiming to notice a pattern or features that determine which numbers are composite and which are prime.

If you can make the number into an array (arrange the counters as a square or rectangle), it’s composite. If it won’t make an array, it’s prime.







Support: Use animal counters to show their guests and give them a list of small numbers to try at first: 12, 16, 17, 20, 23, 25, 27.
Extension 1: Find the ‘golden composite numbers’ under 120. That is, which numbers under 120 have the most factors. A golden composite number has 12 factors. *Templates are three pages below.* A silver composite number has 10. A bronze composite number has 8. How many gold, silver and bronze medals can you collect? Compete against another extension student.
Extension 2: Challenge these students to find the largest prime number that exists, for example, 359 is a prime number. Can you find a larger one?

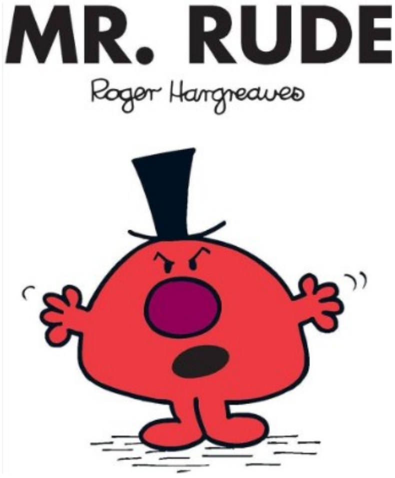
Shade the composite numbers in green and the prime numbers in red. Keep searching for prime numbers.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120

Which numbers are definitely composite (without needing to check using materials)?
How do you know?
What patterns do you notice for primes?

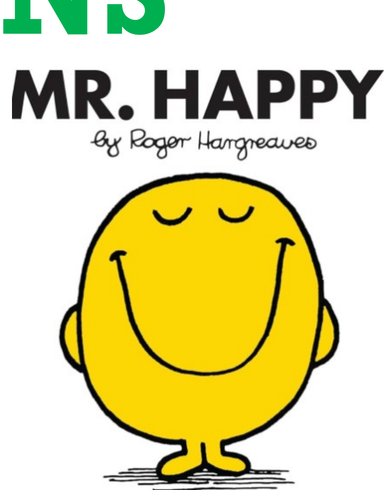
Vocabulary anchor chart for remainders, prime and composite numbers:

RUDE REMAINDERS



PESKY PRIME NUMBER

COMBINATIONS COMPOSITES



Name:

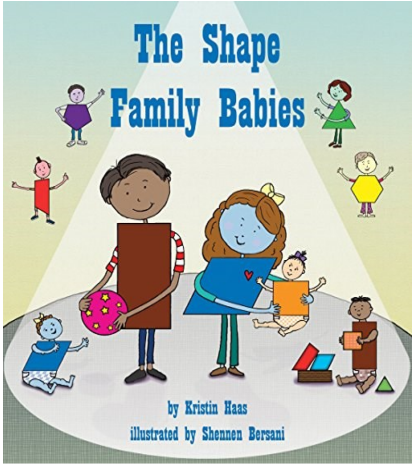
Extension Prime and Composite Medals Score Sheet

Points	Medal awarded	Numbers that qualify (show working out on a separate piece of paper)
5 points	Gold medal numbers – 12 factors or more	
4 points	Silver medal numbers – 10 or 11 factors	
3 points	Bronze medal – 8 or 9 factors	
2 points	Fourth ribbon – 6 or 7 factors	
1 point	Prime trophies – prime numbers (numbers that have 2 factors – 1 and the number itself)	

Answer Sheet

Points	Medal awarded	Numbers that qualify
5 points	Gold medal numbers – 12 factors or more	60, 72, 84, 90, 96
4 points	Silver medal numbers – 10 or 11 factors	48, 80
3 points	Bronze medal – 8 or 9 factors	24, 30, 36, 40, 42, 54, 56, 66, 70, 78, 88, 100
2 points	Fourth ribbon – 6 or 7 factors	20, 28, 32, 44, 45, 50, 52, 63, 64, 68, 75, 76, 92, 98, 99
1 point	Prime trophies – prime numbers	2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97
0 points	Falls into none of the above categories	1 because it does not have 2 factors (only itself)
		All other numbers up to 100

The Shape Family Babies
K. Haas



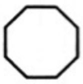
Storyline: Two shapes have a child and the family debates its name according to its features.

Best features: Explicit vocabulary and excellent explanations of the reasons shapes are called by particular names. Personifies shapes as though they are part of a family tree, which is an excellent analogy to make sense of the full range of 2D shapes that exist.

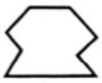
<u>Year 2</u> – Two-dimensional space and structures: Identify and draw two-dimensional shapes and describe their similarities and differences using spatial terms, including opposite, parallel, curved, straight and vertices.
<u>Year 3</u> – Three-dimensional space and structures: Visualise and make models of three-dimensional objects. Compare and classify objects according to the key features of faces, edges and vertices.

SHAPE BARRIER GAME

Read in full, emphasising the language of angles and sides throughout the story, including:
Parallel lines
Right angle
Perpendicular lines
Equal/uneven sides
Quadrilateral
Polygon
Regular (looks normal)



Irregular



Students provide clues to help their partner guess the shape they are hiding behind a barrier. Model the game, particularly the language and the kind of clues that student A could give to student B.

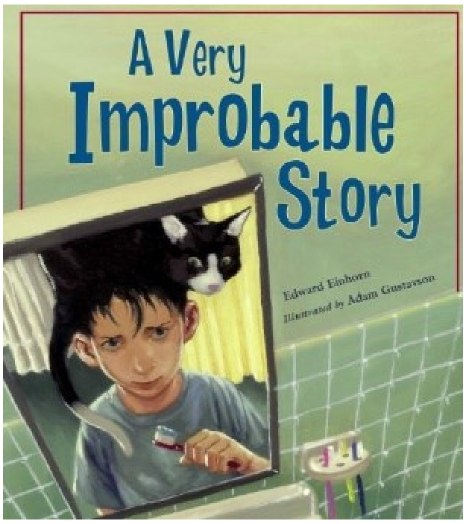
Model that student B should make a list or drawing of each clue as it is provided:

- "My shape is a quadrilateral." Student B scribes down: 4 sides (or draws 4 lines).
- "My shape has 4 right angles." Student B draws a right (L-shaped) angle x 4, and starts to think about rectangles and squares.
- "It has 2 sets of parallel sides." Student B draws these, using arrows to show the lines are travelling in the same direction.
- "All its sides are even." Student B draws a square, checks this against all previous clues and guesses, "SQUARE!"

Support: Limit the shapes in their bag, at first just focusing on squares, rectangles, circles and triangles.
Extension: Provide a wide range of shapes, including shapes they create themselves as cut-outs of A4 coloured paper.

	Variation 1 – Competitive game: Student B asks questions, instead of just receiving clues from student A. Aim to guess the shape using the fewest possible number of questions. However, you can only guess the 'name' of the shape once, so you must be fairly convinced and eliminate all other potential options through your strategic questioning.
	Variation 2 – Descriptor Endurance Battle: Student A and B pull a shape from their 'shape bag.' Both students can see the shape (there is no barrier) and there is only one shape (not one each). They set the timer to 3 minutes and independently write down everything they can think of to describe that shape, similar to the clues list on the previous page. The student with the most descriptions, after the timer dings, wins. Play this as a class with reflection at the end of each round, awarding bonus points for particularly excellent descriptions. For example, for a square, exceptional responses could be: - It has perpendicular and parallel lines. - Its angles sum to 360° but all are equal, just like the length of its sides. - In real-life, you can see this 2D shape as the faces of many 3D cubes or boxes. - It is in both the quadrilateral family (4 sided) and the parallelogram family (2 pairs of parallel sides).

A Very Improbable Story, Einhorn E.



Storyline: Ethan wakes up with a black cat on his head and needs to play probability games to win back his freedom before his soccer match.

Best features: Serves as an entertaining introduction and fun context for a good range of probability games.

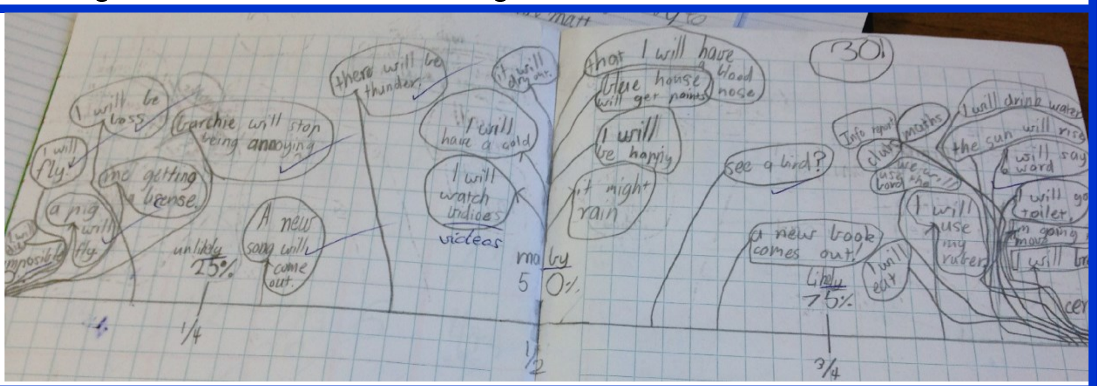
Year 6 – Probability: Order everyday chance events and phrases on a scale from 0 to 1, where 0 represents an event that is certain not to happen (impossible) and 1 represents an event that is certain to happen.

HOW LIKELY IS IT TO WAKE UP WITH A BLACK CAT ON YOUR HEAD?

Read in full, then particularly emphasise page 3.

Use the event of 'waking up with a cat on your head' as a starting point for a discussion about the probability of different events occurring during an average day of students' lives.

Students brainstorm and place events on a probability number line. Brainstorm a class list of some absurd and some normal events, for example, grandma's undies flying into your face, aliens invading, and so on. **Modelling and questioning:** Draw a line, marking 0 at the start and 1 at the end. What is the probability of an alien invasion? Basically on zero or impossible. What is the probability that the sun will rise tomorrow? 1/1 or certain. Create different events that fall at the 50/50 (1/2), likely (3/4) and unlikely (1/4) marks on the line. Students then continue to brainstorm events for each part of the line. For example, as shown in the student sample, a probability of 1 included going to the toilet, drinking water, doing maths (which was on the class timetable) and eating during the day.
Also briefly discuss superstitions, comparing probability-based mathematical thinking to theories of bad luck, such as seeing a black cat, walking under ladders and breaking mirrors.



Support: Emphasise the probability language on their line, such as impossible, unlikely, 50/50 or even chance, likely, and certain.

Extension: Use decimals, fractions and probability language all along on the same line.

<u>Year 6</u> – Probability: Order everyday chance events and phrases on a scale from 0 to 1.

<table>
<tr><th colspan="2">PICK THE MATCHING PAIR</th></tr>
<tr>
<td rowspan="2">Emphasise pages 11 to 13, where Ethan plays a probability game involving his sock drawer.</td>
<td>Students bring in 5-10 pairs of socks and, after placing these all in a non-transparent bag (like their emptied school bag), try to pick out a matching pair without looking.

Materials: 5-10 pairs of clean socks that students bring from home. Large non-transparent bags (students could empty their school backpacks and close their eyes for each turn).

Modelling and questioning:

After a few attempts, students can start to work out the probabilities of picking a matching sock, representing this as a fraction. For example, the student starts with 20 socks in their bag. They pick one. They then try to pick the matching sock and figure out they have a 1/19 chance of doing this, because the remaining sock is 1 out of 19 socks in the bag. Next, leave those first 2 socks out, and continue so that the probabilities change for each round.

Sometimes it will be impossible to pull a matching pair, because its partner has already been removed from the bag. Other times, it will be far more likely than 1/19, given the decreasing number of socks in the bag. So it may end up being 1/5, or even certain if the last two socks remaining in the bag are a pair.</td>
</tr>
<tr>
<td>Support: Start with only 6 socks (3 matching pairs) in the bag and represent the probabilities of finding a matching pair in fractions, focusing on ‘out of’ language such as 1/3 being “1 out of 3.”

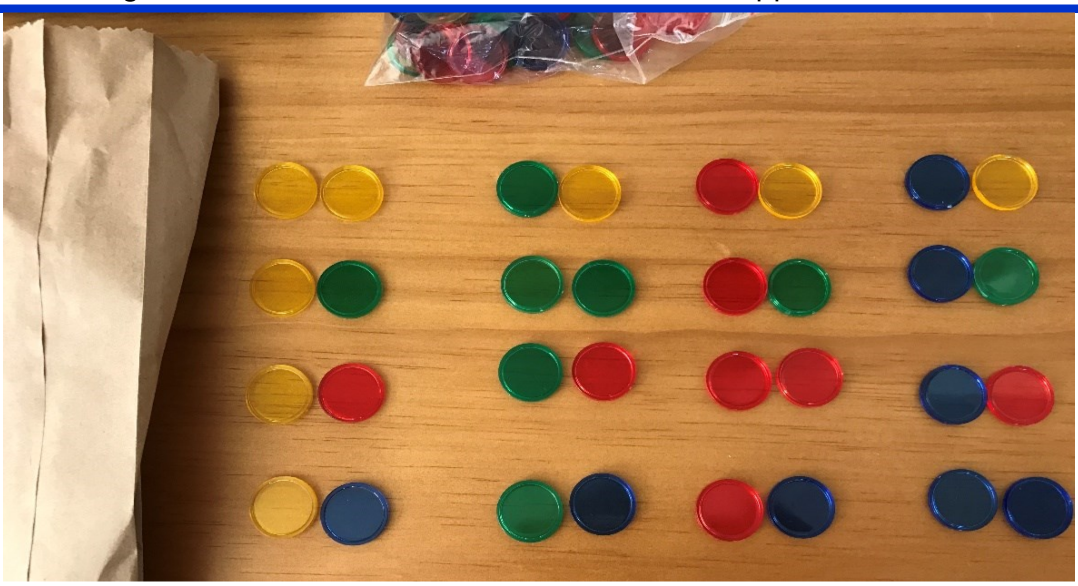
Extension: Try to convert the fractions into decimals and percentages by imagining that there are 100 socks. For example, a 1/5 chance of pulling the matching sock would be the same as 20 out of 100 socks, or 20%, or $0.20 out of $1. You can work this out by thinking about 20 as 1 of 5 parts of 100, or because $1 or 100 cents shared between 5 makes 20^c.</td>
</tr>
</table>

<u>Year 6</u> – **Probability:** Order everyday chance events and phrases on a scale from 0 to 1.

<table>
<tr><th colspan="2">COUNTER COMBINATIONS</th></tr>
<tr><td rowspan="2">Emphasise pages 16 to 21, where Ethan plays a probability game involving coloured marbles.</td><td>Students try to figure out all the possible combinations of coloured counters if they were trying to, like Ethan, pick two of the exact same colour from a paper bag.

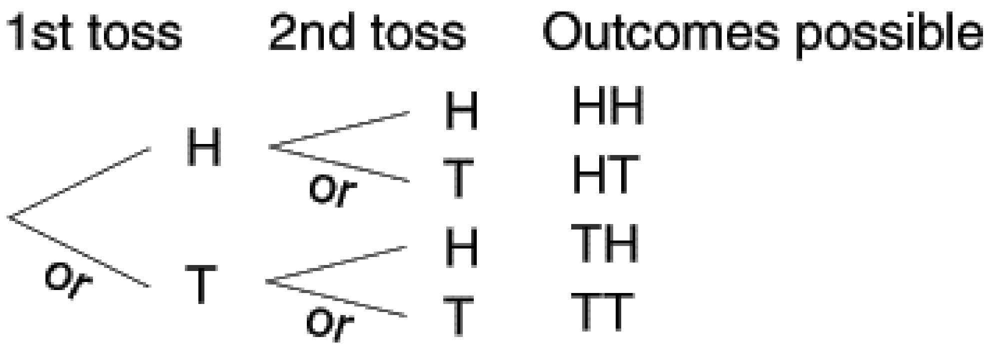
Materials: Multi-coloured counters. Paper bags.

Modelling and questioning: Students put the same number of counters from each colour in a bag, for instance, 4 blue, 4 red, 4 green, 4 yellow. They then try to pick a pair of matching colours from the bag, without looking, pulling from the bag twice and keeping the counter they pulled out of the bag. After a few minutes of attempting this, discuss what students estimate is the probability of choosing a matching colour of counters using probability language (likely, unlikely, 50/50) and fractions (about 1 in every 4 attempts, ¼, one quarter).

Students then use the counters, laying them out like on page 19 of the story, to figure out all the possible combinations and the actual likelihood of choosing their colour twice. Take careful note of the way Ethan laid out the marbles on page 19 and point this out to students. For example, he put a white one at the start for the first column, a green at the start for the second column, so that it was easy and organised for him. Emphasise working in an organised and logical way to figure out the combinations, rather than creating random combinations because this will soon become very confusing and much more difficult than a structured approach.</td></tr>
<tr><td>
Students can then record this in their books using coloured pencils. Work out the probability of each outcome as a fraction:
Two of the yellow is 1/16. However, if you are happy with two of any colour (i.e. yellow yellow, green green, red red, blue blue) it is 4/16 options or 1/4 (1 row out of 4 rows).</td></tr>
</table>

Work out other probabilities too, for example, if you want red blue (but not in any particular order), the probability is 2 out of 16 (2/16) or 1 out of 8 (1/8). To work out the decimal and percentage, if you know ¼ is 25% because $1 shared between 4 is 25ᶜ, then 8 is half of that (12.5% or 0.125).

Students can draw **probability tree diagrams** to represent their findings (relating to coloured counters, rather than coin tosses, as shown here):



Follow-on variations: Students could aim for 3 of the same colour and investigate those probabilities. Start with a different number of counters, for example, 10 red, 10 blue, 10 yellow, 10 green, and figure out the probabilities of a same colour pair, then 3 of the same, and so on. Create a bag and swap with a partner to solve all the possible combinations. Students could also try this investigation within new contexts, for example, combinations available from the canteen for sandwiches, or a lunch combo with types of food and drink.

Support: Start with only 6 counters in the bag.

Extension: Convert each fraction to a percentage and decimal by thinking of the whole as $1 and sharing it between the denominator. For example, for ¼, think of $1 shared between 4 people, each would receive 25ᶜ, or $0.25 or 25% (since percentages are always out of 100 and $1 is 100 cents). For ½, think about $1 shared between 2. For 1/5, think about $1 shared between 5, and so on.

Also use known conversions to figure out the unknown. For example, if you know 1/3 is 0.3333 or 33.33%, you can work out 1/6 is 16.66 or 0.1666% by halving the third. For 1/10, it is 10%, so 1/5 is 20% because each fraction is worth double, since each share is worth double as much as when you are sharing between 10 people.

Very advanced extension: Put a different number of counters from each colour in the bag, working out the possible combinations and their probability. For example, there are 2 blue, 3 yellow, 5 green and 1 red in a bag. What is the probability of a blue-blue combination after two pulls? Put fractions on each branch of the probability tree diagram, then multiply those fractions for the likelihood of that result. For blue-blue, it would be 2/10 (2 out of 10 in the bag) x 1/9 (1 out of 9 left in the bag), so 2/90. For green, it would be 5/10 (5 out of 10), then 4/9 (4 out of 9 left), so 20/90, or 2/9.

<u>Year 6</u> – Probability: Order everyday chance events and phrases on a scale from 0 to 1.

<table>
<tr><th colspan="2">DO YOU THINK I WILL SCORE FROM HERE?</th></tr>
<tr><td rowspan="2">Emphasise pages 28 to 31, where Ethan figures out the probability of him scoring goals in soccer depending on where he kicks the ball.</td><td>Students work out all the probabilities of scoring in a sport of their choice (for example, basketball, soccer, netball, footy) depending on their shooting locations (distances and angles).

Materials: Protractors. Trundle wheels. Soccer/footy balls or basketball/netballs. In terms of the sport equipment for students' chosen sports, you may need to limit their options to two sports to facilitate supervision in a multi-purpose space, for example, an oval next to a basketball court. Alternatively, you could run this session twice, offering soccer and football as the first session choices, and basketball and netball choices during the second session.

Modelling and questioning: Students pick a spot to shoot from and try it out ten times. Students record their scores from each location as a fraction: I scored 4 footy goals out of 10 kicks, 4/10, 40%, $0.40 (earning 10^c per goal). Also record the distance from the goals using trundle wheels. Use a protractor to figure out the angle of their shot from the goals, pointing the 90 degrees straight ahead of them and calculating the angle to reach the centre of the goal. Move to another spot and repeat.
At the end of the session, draw a diagram like Ethan's in the story, but using a birds-eye and to-scale view of the field/court, charting their likelihood of scoring from different distances and angles.
The next session, alter the fractions, with students only attempting 5 shots from each location, or 8, or 3, or 6.</td></tr>
<tr><td>Support: Use tenths/ten shots for all sessions to consolidate this fraction. When confident, move to 5 shots, so each goal is worth 20^c (0.20) or 20%. Pair up with a mixed-ability partner to assist with the protractor use.

Extension: Convert the fractions into decimals and percentages. For example, for a 1/8 chance of scoring = 0.125 = 12.5%. I know this because 100 shared between 8 is 12.5, or $1 shared between 8 people is $0.125 (since $1 shared between 4 is 25^c, so between 8 is half of that = 12.5^c).</td></tr>
</table>