Calculation policy

School vision and values

At Queensbridge we aim to develop well rounded, confident and responsible individuals who aspire to achieve their full potential. We do this by providing a welcoming, inclusive, safe, and supportive learning environment in which everyone is equal and all achievements are celebrated.

RESPECT
- We are responsible for our actions
- We are empathetic
- We are inclusive

COLLABORATION
- We are able to ask for and give support
- We are articulate
- We are a team

PERSEVERANCE
- We don't give up
- We celebrate our mistakes
- We are ambitious

POSSIBILITIES
- We are globally aware
- We are forward thinking
- We are curious

Contents

Introduction
We believe that Mathematics should be an enjoyable subject when taught with the individual's needs in mind. We realise the importance of child centred learning and therefore our whole ethos is based on identifying individual strengths and weaknesses when planning our teaching and learning.
Teachers are aware of the importance of children acquiring secure mental methods of calculation and an efficient written method of calculation for each of the four operations (subtraction, addition, multiplication and division)
At Queensbridge Primary School, we aim to ensure we teach our pupils how they can use and apply their mathematical knowledge, skills and understanding. This we believe will equip our children with the skills which provide tools for life as well as for later study and work.

Rationale
This policy aims to ensure consistency and progression in our approach to calculation with the overall aim that by the end of Year 6 when children leave Queensbridge Primary School to their chosen secondary schools, they should:

- have a secure knowledge of number facts and a good understanding of the four mathematical operation operations (addition, subtraction, multiplication and division) ;
- use the knowledge and understanding of the mathematical operations to carry out calculations mentally and apply general strategies when solving problems involving bigger numbers;
- use diagrams, visual representations and informal notes to help record steps and answers when using mental methods;
- acquire an efficient, reliable, compact written method of calculation for each operation that they can apply with confidence when undertaking calculations that they cannot carry out mentally;
- use and apply their knowledge of number and mathematical operations to solve problems independently with a systematic approach;
- have a clear understand and use a wide range mathematical vocabulary.

Mental methods of calculation
The ability to calculate mentally forms the basis of all methods of calculation and has to be maintained and refined. A good knowledge of numbers or a 'feel' for numbers is the product of structured practice and repetition. It requires an understanding of number patterns and relationships developed through directed enquiry, use of models and images and the application of acquired number knowledge and skills.

Oral and mental calculation in mathematics is essential, particularly so in calculation work. Early practical, oral and mental work must lay the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts.

Written methods of calculation
Being able to use written methods gives children an efficient set of tools they can use when they are unable to carry out the calculation in their heads or do not have access to a

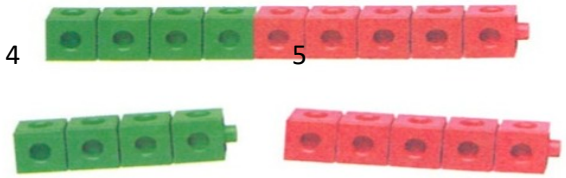
calculator. We want children to know that they have such a reliable, written method to which they can turn when the need arises.

The school aim to equip children to decide when it is best to use a mental, written or calculator method based on the knowledge that they are in control of this choice as they are able to carry out the methods with confidence.

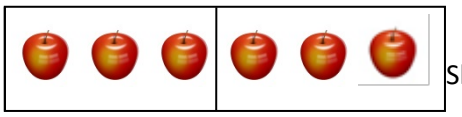
Concrete, Visual, Abstract Approach
At Queensbridge we aim to begin introducing all operations and calculations with concrete objects such as cubes, dienes and numicon. We then move onto visual drawings and representations such as the bar model before moving onto the abstract number sentence.
Please see appendix for an example of these stages.

Early Years and Foundation Stage
Number
Number recognition; children at the end of EYFS should be able to count and order numbers to 20 identify 1 more/less, use single digit numbers to solve addition and subtraction problems.

Addition and Subtraction- using concrete objects, relating to stories and interests. Can become more abstract by counting things such as jumps or claps, following patterns and counting. Early use of the bar method can be used during addition, showing number problems selecting two colours to show 2 parts becoming a whole. Children should begin to write numbers as they become more confident.
eg. 4 + 5 = 9



Division and Multiplication- using concrete objects and relating to stories and interests. Could share images/objects into boxes;


Share the 6 apples between your 2 friends.

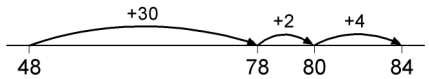
Space, Shape and Measure

Key vocab- big, little, shape, box, in, on, inside, under, long, longer, longest, short, shorter, shortest, heavy, light, full and empty.

Children to use positional and comparative language linked to the real world and objects round them. Identify 2D shapes as flat and 3D shapes as solid, begin to name these shapes using mathematical names.

Addition

Key Vocab: add, increase, total, together, plus, more, and, sum altogether

Year Group Expectations (NC)	Methods
Stage 1 Read, write and interpret mathematical statements involving addition. Represent and use number bonds and related subtraction facts within 20 • add one-digit and two-digit numbers to 20, including zero • solve one-step problems that involve addition, using concrete objects and pictorial representations, and missing number problems such as 9 = 7+ [ ] . **Mental calculation** **Number bonds to 20.**	Number lines 8 + 7 = 15 
Stage 2 Recall and use addition facts to 20 fluently, derive and use related facts up to 100 Add numbers using concrete objects, pictorial representations, and mentally, including: ▪ a two-digit number and ones ▪ a two-digit number and tens ▪ two two-digit numbers ▪ adding three one-digit numbers Show that addition of two numbers can be done in any order (commutative) Recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.	Number lines 48 + 36 = 84  or:  and partition in preparation for column method. $\begin{array}{rcl} 47 & = & 40 + 7 \\ +\underline{76} & & \underline{70 + 6} \\ & & 110 + 13 = 123 \end{array}$ consider alternative below which separates T and U. H T U 60 7 50 4 10 1 - U 100 10 0 - T 100 20 1
Stage 3	Place value column method

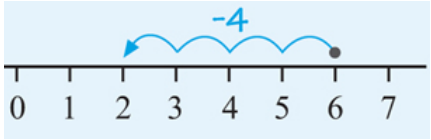
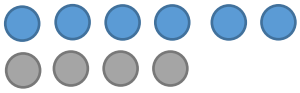
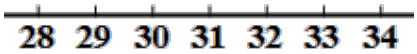
Add numbers mentally, including: ▪ a three-digit number and ones ▪ a three-digit number and tens ▪ a three-digit number and hundreds Add numbers with up to three digits, using formal written methods of columnar addition. Estimate the answer to a calculation and use inverse operations to check answers Solve problems, including missing number problems, using number facts, place value, and more complex addition.	H T U 60 7 50 4 10 1 - U 100 10 0 - T 100 20 1 Condensed Column method 47 + 76 = 123 (11) 258 + 87 = 345 (11) 366 + 458 = 824 (11)
Stage 4 Add numbers with up to 4 digits using the formal written methods of columnar addition where appropriate Estimate and use inverse operations to check answers to a calculation Solve addition two-step problems in contexts, deciding which operations and methods to use and why.	Condensed Column method (bigger numbers) 47 + 76 = 123 (11) 258 + 87 = 345 (11) 366 + 458 = 824 (11)
Stage 5 Add whole numbers with more than 4 digits, including using formal written methods (columnar addition) Add numbers mentally with increasingly large numbers Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy Solve addition multi-step problems in contexts, deciding which operations and methods to use and why.	Condensed Column method (bigger numbers) 47 + 76 = 123 (11) 258 + 87 = 345 (11) 366 + 458 = 824 (11)

Stage 6 Perform mental calculations, including with mixed operations and large numbers Use their knowledge of the order of operations to carry out calculations involving the four operations Solve addition multi-step problems in contexts, deciding which operations and methods to use and why solve problems involving addition, subtraction, multiplication and division Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.	Condensed Column method (bigger numbers) $\begin{array}{r} 47 \\ +\ 76 \\ \hline 123 \\ \hline {\scriptstyle 1\,1} \end{array}$ $\begin{array}{r} 258 \\ +\ 87 \\ \hline 345 \\ \hline {\scriptstyle 1\,1} \end{array}$ $\begin{array}{r} 366 \\ +458 \\ \hline 824 \\ \hline {\scriptstyle 1\,1} \end{array}$

Subtraction

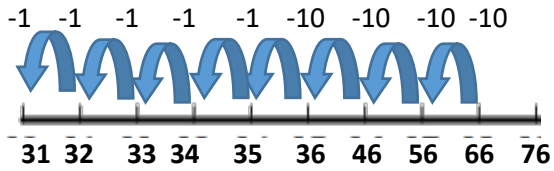
<u>Key Vocab:</u> difference between, take away, reduce, subtract, take from, decrease, minus, fewer

Year Group Expectations (NC)	Methods
Stage 1 Use quantities of objects to subtract 2 single digit numbers and count back to find the answer	Children will engage in a variety of counting songs and rhymes and practical activities. 6 – 2 = 4 'Take two apples away. How many are left?' 

Stage 2 Solve subtraction 1 and 2 digit amounts to 20 using objects and pictures include missing number problems	**<u>Take Away Model</u>** Children will continue to practise counting back from a given number. Initially use a number track to count back for subtraction:  9 – 5 = 4 'Put your finger on the number nine. Count back five.' Then progress to a marked number line:  6-4= 'Put your finger on the number six and count back four.' NB Ensure children are confident with using a marked number line **<u>Difference Model</u>** Counting on to find a small difference: Introduce complementary addition to find differences (only use for small differences). The use of models is extremely important here to understand the idea of "difference". Count up from the smallest number to the largest to find the difference using resources, e.g. cubes, beads, number tracks/lines: 
Stage 3 Subtract numbers using concrete objects, pictorial representations, and mentally, including: o A two digit number and ones o A two digit number and tens o Two two-digit numbers	**<u>Take Away Model</u>** Counting back using an empty number line within 100, in ones… -1 -1 -1 -1 -1 -1 **34 - 6 = 28**   …and in tens: **58 - 30 = 28** -10 -10 -10  **Use in conjunction with a 100 square to show jumps of**

tens.

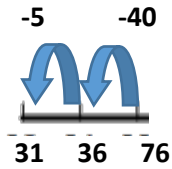
Subtraction, using partitioning, on an empty number line:
76 – 45 = 31



Use in conjunction with a 100 square to show jumps of tens and ones.

If children are confident, use more efficient jumps:

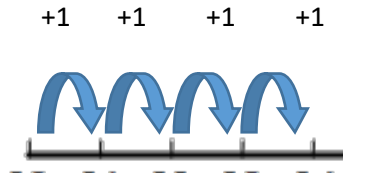
76 – 45 = 31



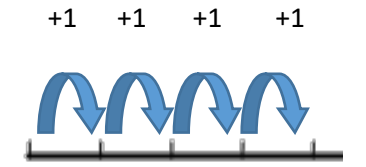
76 – 40 – 5 = 31

Use in conjunction with a 100 square to show jumps of tens and ones.
Continue to use more efficient jumps with number line that bridge 100

<u>Difference Model</u>
Count up from the smallest number to the largest **to find the difference.**
Introduce complementary addition to find differences (only use for small differences). The use of models is extremely important here to understand the idea of "difference" (see Y1 guidance).
12 - 8 = 4



32- 28 = 4



	'The difference between 28 and 32 is 4.' **28 29 30 31 32** **76 – 58 = 18** +2 +10 +6  'The difference between 58 and 76 is 18.' **58 60 70 76** Further develop subtraction with numbers that bridge 100, using a 200 grid to support. NB If, at any time, children are making significant errors, return to the previous stage in calculation.
Stage 3 / 4 Expanded written method add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction	Introduce the expanded written method with the calculation presented both horizontally and vertically (in columns). Use two-digit numbers when introducing this method, initially: 78 – 23 = 55 70 + 8 70 and 8 –20 + 3 -20 and 3 ---------- 50 + 5 = 55 ***You might replace the + sign with the word 'and' to avoid confusion.*** This will lead into the formal written method: 78 - 2 3 ---------- 5 5 ***NB A number line would be an appropriate method for this calculation but use two digit numbers to illustrate the formal written method initially.***
Stage 4/5 Subtract numbers with up to 4 digits using the formal written method of columnar subtraction	Introduce the expanded written method where exchange/decomposition is required: 73 – 27 = 46 70 + 3 becomes 60 +13 - 20 + 7 - 20 + 7 ---------- 40 + 6 = 46 ***NB children will need to practise partitioning numbers in this way. Base- ten materials could be used to support this.*** When children are confident with the expanded method introduce the formal written method, involving decomposition/exchange:

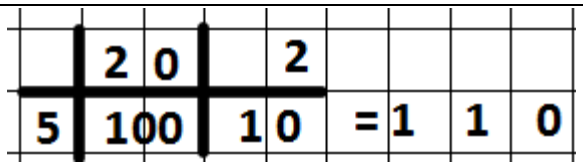
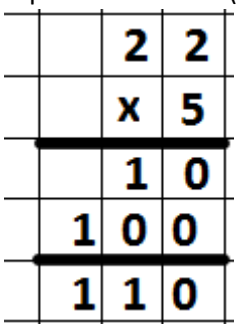
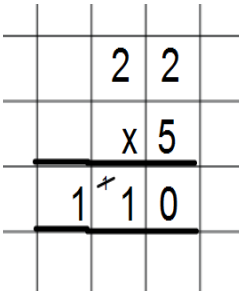
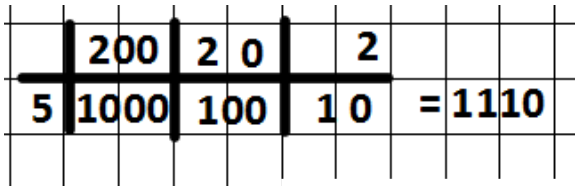
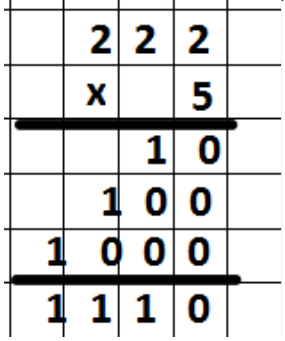
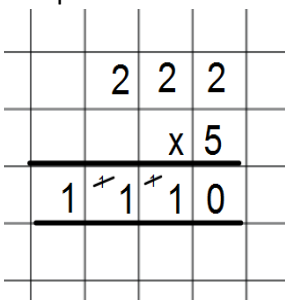
	73 – 27 = 46 6 13 ~~7~~~~3~~ - 2 7 ---------- 4 6 **If children are confident, extend the use of the formal written method with numbers over 100, returning to the expanded method first, if necessary.** 235 – 127 = 108 2 15 2 ~~3~~~~5~~ - 1 2 7 ---------- 1 0 8 NB If, at any time, children are making significant errors, return to the previous stage in calculation.

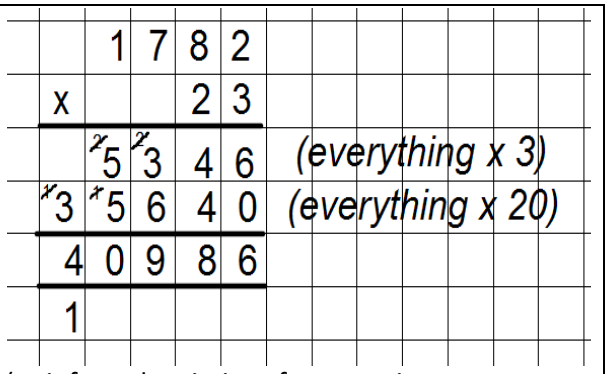
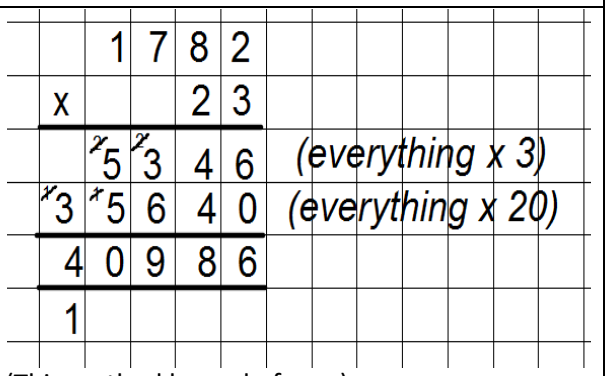
Multiplication

It is important to note that although 5 x 3 = 15 and 3 x 5 = 15 are the same when discussing with the children then first number in the calculation is the number of groups. The second number being the quantity within each group. Eg. 5 x 3 is 5 groups of 3, the repeated addition would therefore be 3+3+3+3+3 This is important when teaching the early stages of multiplication through arrays and repeated addition. It will also be important when using the bar model to represent multiplication problems.

Key Vocab: groups of, times by, multiplied by, times table, lots of, times, multiply, product

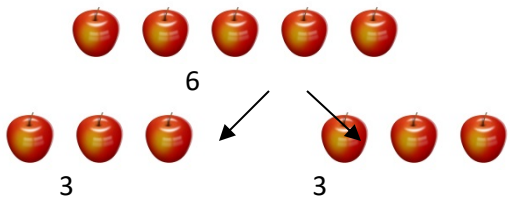
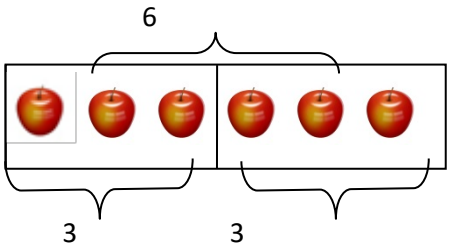
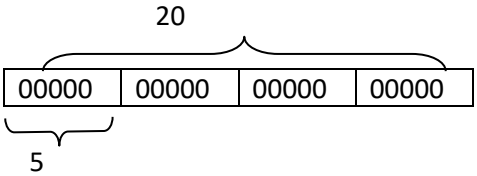
Year Group Expectations (NC)	Methods
Stage 1 Begin to count in 2s, 5s and 10s. Being to say what three 5s are by counting in 5s. Double numbers to 10.	Use pictorial representations, maths resources (Numicon) and concrete objects (groups of cubes).
Stage 2 Count in 2s, 5s and 10s. Begin to count in 3s. Begin to understand that multiplication is repeated addition and use arrays. E.g. 3 x 4 is 3 rows of 4 dots. Being to learn the x2, x3, x5, 10 tables. Double numbers to 20. Being to double multiples of 5 to 100. Begin to double 2-digit numbers less than 50 with units up to 5.	Use repeated addition: 3 x 2 = 2 + 2 + 2 Organise arrays: **** **** **** = 3 x 4
Stage 3 Know by heart all the multiplication facts in the ×2, ×3, ×4, ×5, ×8 and ×10 tables	22 x 5 = Grid Method (informal)

Multiply whole numbers by 10 and 100 Recognise that multiplication is commutative Use place value and number facts in mental multiplication e.g. *30 × 5 is 15 × 10* Partition teen numbers to multiply by a 1-digit number e.g. *3 × 14 as 3 × 10 and 3 × 4* Double numbers up to 50	 Expanded Method (formal)   Compact
Stage 4 Know by heart all the multiplication facts up to 12 × 12 Recognise factors up to 12 of 2-digit numbers Multiply whole numbers and 1-place decimals by 10, 100, 1000 Multiply multiples of 10, 100 and 1000 by 1-digit numbers e.g. *300 × 6* e.g. *4000 × 8* Use understanding of place value and number facts in mental multiplication e.g. *36 × 5 is half of 36 × 10* e.g. *50 × 60 = 3000* Partition 2-digit numbers to multiply by a 1-digit number mentally e.g. *4 × 24 as 4 × 20 and 4 × 4* Multiply near multiples by rounding e.g. *33 × 19 as (33 × 20) – 33* Find doubles to double 100 and beyond using partitioning Begin to double amounts of money e.g. *£35·60 doubled is £71·20*	222 x 5 =   Compact 
Stage 5 Know by heart all the multiplication facts up to 12 × 12 Multiply whole numbers and 1- and 2-place decimals by 10, 100, 1000, 10 000 Use knowledge of factors and multiples in multiplication e.g. *43 × 6 is double 43 × 3* e.g. *28 × 50 is $^{1}/_{2}$ of 28 × 100 = 1400*	23 x 1782 =

Use knowledge of place value and rounding in mental multiplication e.g. *67 × 199 as 67 × 200 – 67* Use doubling and halving as a strategy in mental multiplication e.g. *58 × 5 is half of 58 × 10* e.g. *34 × 4 is 34 doubled twice* Partition 2-digit numbers, including decimals, to multiply by a 1-digit number mentally e.g. *6 × 27 as 6 × 20 (120) plus 6 × 7 (42)* e.g. *6·3 × 7 as 6 × 7 (42) plus 0·3 × 7 (2·1)* Double amounts of money by partitioning e.g. *£37·45 doubled is £37 doubled (£74) plus 45p doubled (90p) giving a total of £74·90*	 (or informal variations from previous year to bridge the gap)
Stage 6 Know by heart all the multiplication facts up to 12 × 12 Multiply whole numbers and decimals with up to 3 places by 10, 100 or 1000 e.g. *234 × 1000 = 234 000* e.g. *0·23 × 1000 = 230* Identify common factors, common multiples and prime numbers and use factors in mental multiplication e.g. *326 × 6 is 652 × 3 which is 1956* Use place value and number facts in mental multiplication e.g. *4000 × 6 = 24 000* e.g. *0·03 × 6 = 0·18* Use doubling and halving as mental multiplication strategies, including to multiply by 2, 4, 8, 5, 20, 50 and 25 e.g. *28 × 25 is a quarter of 28 × 100 = 700* Use rounding in mental multiplication e.g. *34 × 19 as (34 × 20) – 34* Multiply 1- and 2-place decimals by numbers up to and including 10 using place value and partitioning e.g. *3·6 × 4 is 12 + 2·4* e.g. *2·53 × 3 is 6 + 1·5 + 0·09* Double decimal numbers with up to 2 places using partitioning e.g. *36·73 doubled is double 36 (72) plus double 0·73 (1·46)*	 (This method by end of year)

Division

<u>Key Vocab:</u> divide into, divide, share, divisible by, share between, divide by, group

Year Group Expectations (NC)	Stages of division
Stage 1 Solve one-step problems using concrete objects, pictorial representations and arrays with the support of the teacher.	
Stage 2 Introduction of signs division (÷) and equals (=) signs Solve problems involving division, using materials, arrays, repeated addition	 6 ÷ 2 = 3 Corresponding number facts: 3 + 3 = 6 3 × 2 = 6
Stage 3 Write and calculate mathematical statements for division including two-digit numbers by one-digit numbers, using mental and progressing to formal written methods. Inverse recall of number facts	20 ÷ 4 = 5 
Stage 4 Use place value, known and derived facts to multiply and divide mentally, dividing by 1	For larger numbers children can use number knowledge and partitioning to share equally 44 ÷ 4 = 11 40 4 10 + 1 | 10 + 1 | 10 + 1 | 10 + 1 Children then move onto chunking to divide 47 ÷ 3 = 10 x 3 = 30 10 groups of 3 make 30 so this can be subtracted from the total 47 – 30 = 17 5 x 3 = 15 5 groups of 3 make 15 so this can be subtracted from the new total 17-15= 2 this is the remainder, the amount that cannot be equally shared 10 groups made 30, 5 groups made 15 so 10 + 5 = 15 r 2

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Stage 5

Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context

Divide whole numbers and those involving decimals by 10, 100 and 1000

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Formal written methods of division are used;

196 ÷ 6 =

```
   032 r 4
6 |196        6 does not go into 19
  18 ↓        It does go into 18  3 times
   16
   12
   04
```

There is 1 ten left over which is joined with the 6 from the units column. Six can be divided into 12 twice leaving a remainder of 4

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     028.8            ÷3
15 |43 13 2. 12 0     or  12    4  =  0.8
                         15    5
                          ÷3
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Stage 6

Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context

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