Great Meols Primary School

Calculation Policy for Mathematics Years 3 and 4

April 2017

About our Calculation Policy

(This document contains embedded video links which can be accessed if you are reading an electronic version.)

The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school.

Age/Stage expectations

The calculation policy is organised according to Age/Stage expectations as set out in the National Curriculum 2014, **however it is vital that pupils are taught according to the stage that they are currently working at,** being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons.

Choosing a calculation method:

Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved:

Can I do it in my head using a mental strategy?

Could I use some jottings to help me?

Should I use a written method to work it out?

To work out a tricky calculation:
Approximate.
Calculate.
Check it !

Addition

Year 3 **Add numbers with up to 3-digits**

Introduce the **expanded column addition** method:

	H	T	U
	2	3	6
+		7	3
			9
	1	0	0
	2	0	0
	3	0	9

(6+ 3)
(30+70)
(200+0)

Add the **units** first, in preparation for the compact method.

In order to carry out this method of addition:

- Children need to recognise the value of the hundreds, tens and units without recording the partition.
- Pupils need to be able to add in columns.

Move to the compact **column addition** method, with 'carrying'

Add **units** first.

'Carry' numbers **underneath** the bottom line.

H	T	U
2	3	6
+	7	3
3	0	9
1		

Children who are very secure and confident with 3-digit expanded column addition should be moved onto the **compact column addition** method, being introduced to **'carrying'** for the first time. Compare the expanded method to the compact column method to develop an understanding of the process and the reduced number of steps involved.

Remind pupils the actual value is '**three tens** add **seven tens**', not 'three add seven', which equals **ten** tens.

Key vocabulary: add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, plus, addition, column, tens boundary,

New vocabulary - hundreds boundary, increase, vertical, carry, expanded, compact

Key skills for addition at Y3:

- Read and write numbers to 1000 in numerals and words.
- Add 2-digit numbers mentally, incl. those exceeding 100.
- **Add a three-digit number and ones mentally (175 + 8)**
- **Add a three-digit number and tens mentally (249 + 50)**
- **Add a three-digit number and hundreds mentally (381 + 400)**
- Estimate answers to calculations, using inverse to check answers.
- Solve problems, including missing number problems, using
- number facts, place value, and more complex addition.
- Recognise place value of each digit in 3-digit numbers (hundreds, tens, ones.)
- Continue to practise a wide range of mental addition strategies, ie. number bonds, adding the nearest multiple of 10, 100, 100 and adjusting, using near doubles, partitioning and recombining.

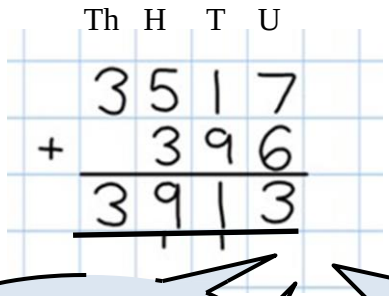
Video clip: Demonstration of expanded 3-digit column addition

Addition

Year 4 Add numbers with up to 4 digits

Move from expanded addition to the compact column method, **adding units first**, and 'carrying' numbers **underneath** the calculation. Also include money and measures contexts.

e.g. 3517 + 396 = 3913



Introduce the **compact column addition** method by asking children to add the two given numbers together using the method that they are familiar with (expanded column addition—see Y3). Teacher models the compact method with carrying, asking children to discuss similarities and differences and establish how it is carried out.

Add **units** first.

'Carry' numbers **underneath** the bottom line.

Reinforce correct place value by reminding them the actual value is 5 hundreds add 3 hundreds, **not 5 add 3**, for example.

Use and apply this method to money and measurement values.

Key vocabulary: add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, units, partition, plus, addition, column, tens boundary, hundreds boundary, increase, vertical, 'carry', expanded, compact,

New vocabulary - thousands, hundreds, digits, inverse

Key skills for addition at Y4:

- Select most appropriate method: mental, jottings or written and explain why.
- Recognise the place value of each digit in a four-digit number.
- Round any number to the nearest 10, 100 or 1000.
- Estimate and use inverse operations to check answers.
- Solve 2-step problems in context, deciding which operations and methods to use and why.
- Find 1000 more or less than a given number.
- Continue to practise a wide range of mental addition strategies, ie. number bonds, add the nearest multiple of 10, 100, 1000 and adjust, use near doubles, partitioning and recombining.
- Add numbers with up to 4 digits using the formal written method of column addition
- Solve 2-step problems in contexts, deciding which operations and methods to use and why.
- Estimate and use inverse operations to check answers to a calculation.

Subtraction

Year 3 Subtracting with 2 and 3-digit numbers.

Introduce **partitioned column subtraction** method.

STEP 1: introduce this method with examples where **no exchanging** is required.

89 – 35 = 54

$$\begin{array}{r} 80 + 9 \\ -\ 30 + 5 \\ \hline 50 + 4 \\ \hline \end{array}$$

When learning to 'exchange', explore 'partitioning in different ways' so that pupils understand that when you exchange, the **VALUE** is the same ie **72** = 70+2 = 60+12 = 50+22 etc. Emphasise that the **value hasn't changed**, we have just partitioned it in a different way.

STEP 2: introduce exchanging through *practical subtraction.* Make the larger number with Base 10, then subtract 47 from it.

72 - 47

$$\begin{array}{r} \cancel{70}^{60} + {}^{1}2 \\ -\ 40 + 7 \\ \hline \cancel{20 + 5} \\ \hline \end{array} = 25$$

Before subtracting '7' from the 72 blocks, they will need to exchange a row of 10 for ten units. Then subtract 7, and subtract 4 tens.

STEP 3: Once pupils are secure with the understanding of "exchanging", they can use the partitioned column method to subtract any 2 and 3-digit numbers.

238 - 146 = 92

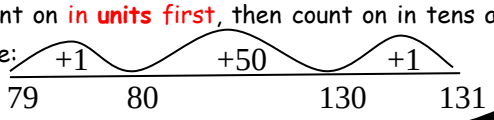
$$\begin{array}{r} \cancel{200}^{100} + {}^{1}30 + 8 \\ -\ 100 + 40 + 6 \\ \hline 0 + 90 + 2 \\ \hline \end{array}$$

Subtracting money: partition into e.g. £1 + 30p + 8p

Counting on as a mental strategy for subtraction:

Continue to reinforce counting **on** as a strategy for **close-together numbers** (e.g. 121—118), and also for numbers that are 'nearly' multiples of 10, 100, 1000 or £s, which make it easier to count on (e.g. 102-89, 131—79, or calculating change from £1 etc.).

- Start at the smaller number and count on in **units** first, then count on in tens and then units to find the rest of the difference:



Key vocabulary: equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer/less than, most, least, count back , how many left how much less is, difference, count on, partition, tens, units **New vocabulary - exchange, decrease, hundreds, value, digit**

Key skills for subtraction at Y3:

- Subtract mentally a: **3-digit number and ones, 3-digit number and tens, 3-digit number and hundreds** .
- Estimate answers and use inverse operations to check.
- Solve problems, including missing number problems.
- Find 10 or 100 more or less than a given number.
- Recognise the place value of each digit in a 3-digit number .
- Counting up differences as a mental strategy when numbers are close together or near multiples of 10 (see examples above)
- Read and write numbers up to 1000 in numerals and words.
- Practise mental subtraction strategies, such as subtracting near multiples of 10 and adjusting (e.g. subtracting 19 or 21), and select most appropriate methods to subtract, explaining why.

Approximate,

Calculate,

Check it !

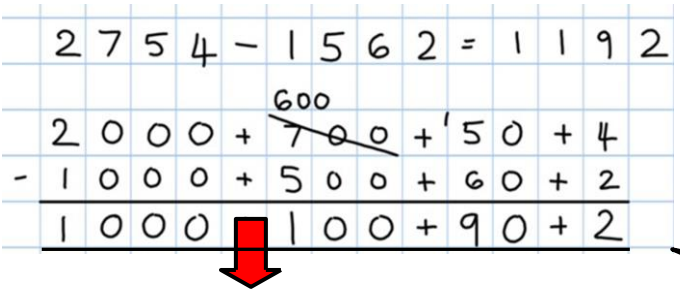
Video clips: 1 Subtraction—teaching children to consider the most appropriate methods before calculating

2 Introducing partitioned column subtraction method, from practical to written

Subtraction

Year 4 Subtract with up to 4-digit numbers

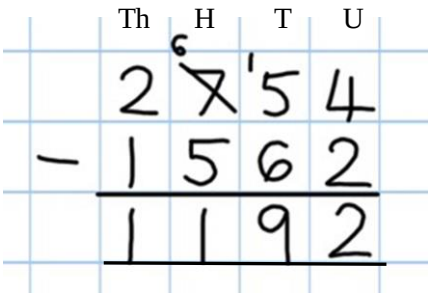
Partitioned column subtraction with 'exchanging' (decomposition):



As introduced in Y3, but moving towards more complex numbers and values. Use **place value counters** to reinforce 'exchanging'.

Subtracting money: partition into £1 + 30 + 5 for example.

Compact column subtraction (see video)



To introduce the compact method, ask children to perform a subtraction calculation with the familiar partitioned column subtraction then display the compact version for the calculation they have done. Ask pupils to consider how it relates to the method they know, what is similar and what is different, to develop an understanding of it (shown on video).

Give plenty of opportunities to apply this to money and measures.

Always encourage children to consider the best method for the numbers involved—mental, counting on, counting back or written method (see video).

Mental strategies

A variety of mental strategies must be taught and practised, including counting on to find the difference where numbers are closer together, or where it is easier to count on (see video below).

Approximate,
Calculate,
Check it !

Key vocabulary: equal to, take, take away, less, minus, subtract, leaves, distance between, how many more, how many fewer/less than, most, least, count back , how many left, how much less is ? difference, count on, partition, tens, units exchange, decrease, hundreds, value, digit,

New vocabulary - inverse

Key skills for subtraction at Y4:

- Subtract by counting on where numbers are close together or they are near to multiples of 10, 100 etc.
- Children select the most appropriate and efficient methods for given subtraction calculations.
- Estimate and use inverse operations to check answers.
- Solve addition and subtraction 2-step problems, choosing which operations and methods to use and why.
- Solve simple measure and money problems involving fractions and decimals to two decimal places.
- Find 1000 more or less than a given number.
- Count backwards through zero, including negative numbers.
- Recognise place value of each digit in a 4-digit number. Round any number to the nearest 10, 100 or 1000
- Solve number and practical problems that involve the above, with increasingly large positive numbers.

Videos: 1—Subtraction—teaching children to consider the most appropriate methods before calculating
2—Introducing partitioned column subtraction method, from practical to written
3—Moving to the compact column method of subtraction

Multiplication

Year 3 Multiply 2-digits by a single digit number

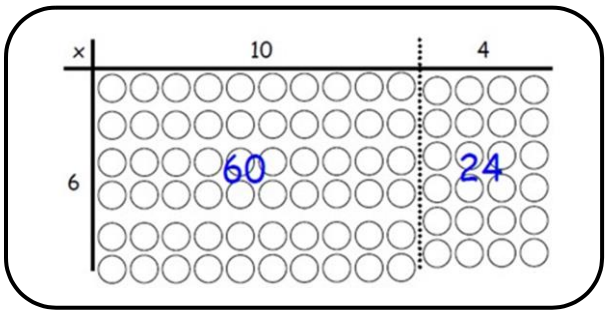
Introduce the grid method for multiplying 2-digit by single-digits:

Link the layout of the grid to an array initially:

Eg. 23 x 8 = 184

X	20	3
8	160	24

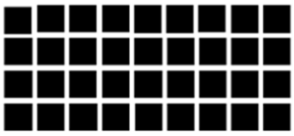
160
+ 24
184



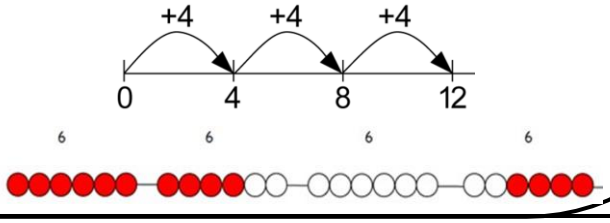
Introduce the grid method with children physically making an array to represent the calculation (e.g. make 8 lots of 23 with 10s and 1s place value counters), then translate this to grid method format.

To do this, children must be able to:

- Partition numbers into tens and units
- Multiply multiples of ten by a single digit (e.g. 20 x 4) using their knowledge of multiplication facts and place value
- Recall and work out multiplication facts in the **2, 3, 4, 5, 8 and 10** times tables.
- Work out multiplication facts not known by repeated addition or other taught mental strategies (e.g. by commutative law, working out near multiples and adjusting, using doubling etc.) Strategies to support this are repeated addition using a number line, bead bars and arrays:



9 x 4 = 36



Key vocabulary: groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times, _times as big as, once, twice, three times...,

New vocabulary - partition, grid method, multiple, product, tens, units, value

Key skills for multiplication:

- Recall and use multiplication facts for the **2, 3, 4, 5, 8 and 10** multiplication tables, and multiply multiples of 10.
- Write and calculate number statements using the multiplication tables they know, including **2-digit x single-digit**, drawing upon mental methods, and progressing to reliable written methods.
- Solve multiplication problems, including missing number problems.
- Develop mental strategies using commutativity (e.g. 4 x 12 x 5 = 4 x 5 x 12 = 20 x 12 = 240)
- Solve simple problems in contexts, deciding which operations and methods to use.
- Develop efficient mental methods to solve a range of problems e.g using commutativity (**4 × 12 × 5** = 4 × 5 × 12 = **20 × 12** = 240) and for missing number problems ? x 5 = 20, 3 x ? = 18, ? x 1 = 32

Multiplication

Year 4 Multiply 2 and 3-digits by a single digit, using all multiplication tables up to 12 x 12

Developing the grid method:

Eg. 136 x 5 = 680

X	100	30	6
5	500	150	30

500
150
+ 30
680

Encourage column addition to add accurately

Move onto **short multiplication** (see Y5) if and when children are confident and accurate multiplying 2 and 3 digit numbers by a single digit this way, **and** are already confident in 'carrying' for written addition.

Children should be able to:

- **Approximate before they calculate**, and make this a regular part of their calculating, going back to the approximation to check the reasonableness of their answer. e.g: **346 x 9** is approximately 350 x 10 = **3500**
- Record an approximation to check the final answer against.
- Multiply multiples of ten and one hundred by a single-digit, using their multiplication table knowledge.
- Recall all times tables **up to 12 x 12**

Approximate,
Calculate,
Check it !

Key vocabulary: groups of, lots of, times, array, altogether, multiply, count, multiplied by, repeated addition, array, column, row, commutative, groups of, sets of, lots of, equal groups, times, multiply, times as big as, once, twice, three times... partition, grid method, total, multiple, product, sets of,

New vocabulary - inverse

Key skills for multiplication at Y4:

- Count in multiples of 6, 7, 9, 25 and 1000
- Recall multiplication facts for **all multiplication tables up to 12 x 12.**
- Recognise place value of digits in up to 4-digit numbers
- Use place value, known facts and derived facts to multiply mentally, e.g. multiply by 1, 10, 100, by 0, or to multiply 3 numbers.
- Use commutativity and other strategies mentally 3 x 6 = 6 x 3 , 2 x 6 x 5 = 10 x 6 , 39x7 = 30 x 7 + 9 x 7.
- Solve problems with increasingly complex multiplication in a range of contexts.
- Count in multiples of 6, 7, 9, 25 and 1000
- Recognise the place value of each digit in a four-digit number (thousands, hundreds, tens, and ones)

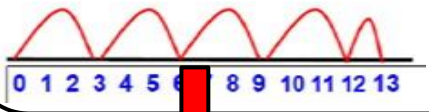
Division

Year 3 Divide 2-digit numbers by a single digit (where there is no remainder in the final answer)

Grouping on a number line:

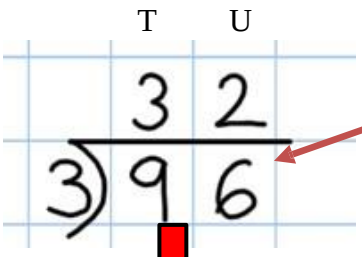
13 ÷ 3 = 4 r 1

+3 +3 +3 +3 r 1



STEP 1: Children continue to work out unknown division facts by grouping on a number line from zero. They are also now taught the concept of **remainders**, as in the example. This should be introduced practically and with arrays, as well as being translated to a number line. Children should work towards calculating some basic division facts with remainders mentally for the 2s, 3s, 4s, 5s, 8s and 10s, ready for 'carrying' remainders across within the short division method.

Short division: Limit numbers to NO remainders in the answer OR carried (each digit must be a multiple of the divisor).

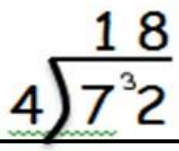


STEP 2: Once children are secure with division as grouping and demonstrate this using number lines, arrays etc., **short division** for larger 2-digit numbers should be introduced, initially with carefully selected examples requiring no calculating of remainders at all. Start by introducing the layout of short division by comparing it to an array.

Remind children of correct place value, that 96 is equal to 90 and 6, but in short division, pose:

- How many 3's in 9? = 3, and record it above the **9 tens**.
- How many 3's in 6? = 2, and record it above the **6 units**.

Short division: Limit numbers to NO remainders in the final answer, but with remainders occurring within the calculation.



STEP 3: Once children demonstrate a full understanding of remainders, and also the short division method taught, they can be taught how to use the method when remainders occur within the calculation (e.g. 96+4), and be taught to 'carry' the remainder onto the next digit. **If needed, children should use the number line to work out individual division facts that occur which they are not yet able to recall mentally.**

Real life contexts need to be used routinely to help pupils gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

Key Vocabulary: share, share equally, one each, two each…, group, equal groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over,

New vocabulary - inverse, short division, 'carry', remainder, multiple

Key number skills needed for division at Y3:

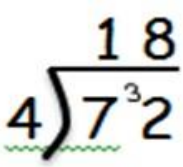
- Recall and use multiplication and division facts for the 2, 3, 4, 5, 8 and 10 multiplication tables (through doubling, connect the 2, 4 and 8s).
- Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.
- Solve problems, in contexts, and including missing number problems, involving multiplication and division.
- Pupils develop efficient mental methods, for example, using multiplication and division facts (e.g. using 3 × 2 =6, 6 ÷ 3 = 2 and 2 = 6 ÷ 3) to derive related facts (30 × 2 = 60, so 60 ÷ 3 = 20 and 20 = 60 ÷ 3).
- Pupils develop reliable written methods for division, starting with calculations of 2-digit numbers by 1-digit numbers and progressing to the formal written method of short division.

Division

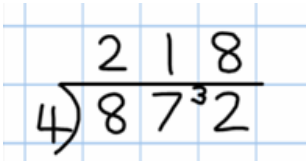
Year 4 Divide up to 3-digit numbers by a single digit (without remainders initially)

Continue to develop short division:

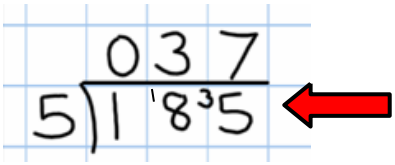
Short division should only be taught once children have secured the skill of calculating 'remainders'.



STEP 1: Pupils must be secure with the process of short division for dividing 2-digit numbers by a single digit (**those that do not result in a final remainder** see steps in Y3), but must understand how to calculate remainders, using this to 'carry' remainders within the calculation process (see example).



STEP 2: Pupils move onto dividing numbers with up to **3-digits** by a single digit, however problems and calculations provided should **not result in a final answer with remainder** at this stage. Children who exceed this expectation may progress to Y5 level.



When the answer for the **first column** is zero (1 ÷ 5, as in example), children could initially write a zero above to acknowledge its place, and must always 'carry' the number (1) over to the next digit as a remainder.

Include money and measure contexts when confident.

Real life contexts need to be used routinely to help pupils gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

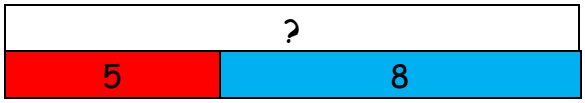
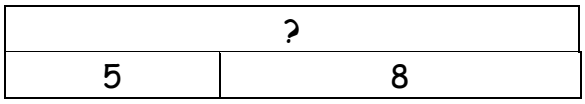
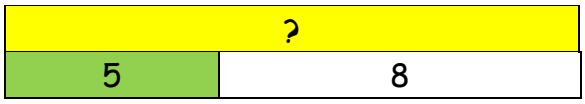
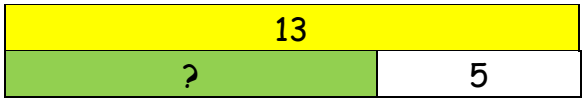
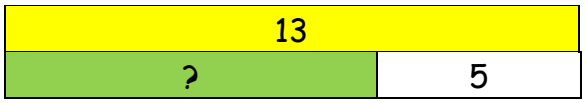
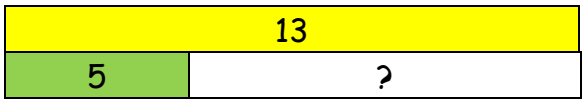
Key Vocabulary: share, share equally, one each, two each…, group, equal groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over, inverse, short division, 'carry', remainder, multiple. **New vocabulary - divisible by, factor**

Key number skills needed for division at Y4:

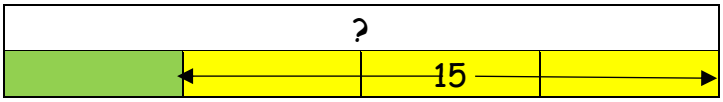
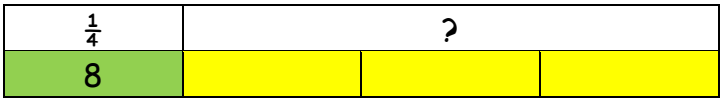
- **Recall multiplication and division facts for all numbers up to 12 x 12.**
- Use place value, known and derived facts to multiply and divide mentally, including: multiplying and dividing by 10 and 100 and 1.
- Pupils practise to become fluent in the formal written method of short division with exact answers when dividing by a one-digit number
- Pupils practise mental methods and extend this to three-digit numbers to derive facts, for example 200 × 3 = 600 so 600 ÷ 3 = 200
- Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as three cakes shared equally between 10 children.
- to specified degrees of accuracy.

Bar Modelling Strategy

Bar Modelling is used as a pictorial aid to support the children's understanding alongside other methods that are taught as set out in the school Calculation policy. For each maths operation examples are shown. Children across Key Stage 1 and Key Stage 2 will use the model appropriate to their learning.

Operation	Problem type	Example	Bar Model
Addition	Part-Whole Model for Addition (combining two quantities)	Connie has 5 red marbles and 8 blue marbles. How many marbles does she have?	 5+8=13 Connie has 13 marbles.
	Part-Whole Model for Addition (increasing a quantity)	Connie had 5 marbles. John gave her 8 more marbles. How many marbles does Connie have altogether?	 5+8=13 Connie has 13 marbles.
	Comparison Model for Addition (finding the bigger quantity)	John has 5 marbles. Connie has 8 more than John. How many marbles does Connie have?	 5+8=13 Connie has 13 marbles.
Subtraction	Part-Whole Model for Subtraction (finding a missing quantity)	Connie had 13 marbles. She gave some to John. Now she has 5 marbles left. How may marbles did Connie give to John?	 13-5=8 Connie gave 8 marbles to John.
	Comparison Model for Subtraction (finding the smaller quantity)	Connie has 13 marbles. She has 5 more marbles than John. How many marbles does John have?	 13-5=8 John has 8 marbles.
	Comparison Model for Subtraction (finding the difference)	Connie has 13 marbles. John has 5 marbles. How many more marbles does Connie have than John?	 13-5=8 Connie has 8 more marbles than John.

<table>
<tr><td rowspan="2">Multiplication</td><td>Part-Whole Model for Multiplication (finding the whole)</td><td>Connie has five bags of marbles. Each bag has 6 marbles. How many marbles does Connie have?</td><td><table><tr><td>6</td><td>6</td><td>6</td><td>6</td><td>6</td></tr><tr><td colspan="5">?</td></tr></table>6x5=30 Connie has 30 marbles.</td></tr>
<tr><td>Comparison Model for Multiplication (finding the bigger quantity)</td><td>Connie has 3 marbles. John has four times as many marbles as Connie. How many marbles does John have?</td><td><table><tr><td>3</td><td>3</td><td>3</td><td>3</td></tr><tr><td colspan="4">?</td></tr></table>3x4=12 John has 12 marbles.</td></tr>
<tr><td rowspan="4">Division</td><td>Part-Whole Model for Division (finding one part)</td><td>Connie has 18 marbles. She splits them equally between 6 bags. How many marbles are in each bag?</td><td><table><tr><td colspan="6">18</td></tr><tr><td>?</td><td></td><td></td><td></td><td></td><td></td></tr></table>18÷6=3 There are 3 marbles in each bag.</td></tr>
<tr><td>Part-Whole Model for Division (finding how many parts)</td><td>Connie has 24 marbles. She gives 4 marbles to each of her friends. How many of her friends does she share them with?</td><td><table><tr><td colspan="6">24</td></tr><tr><td>4</td><td>4</td><td>4</td><td>4</td><td>4</td><td>4</td></tr></table>24÷4=6 Connie shares with 6 friends.</td></tr>
<tr><td>Part-whole model for division (finding a remainder)</td><td>Connie shares her 30 marbles equally between her 7 friends. How many marbles does she have left</td><td><table><tr><td colspan="8">30</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>?</td></tr></table>30÷7=4r2 Connie has 2 marbles left.</td></tr>
<tr><td>Comparison Model for Division (finding the multiplier)</td><td>Connie has 36 marbles. John has 12 marbles. How many times more marbles has Connie got than John?</td><td><table><tr><td colspan="3">36</td></tr><tr><td>12</td><td></td><td></td></tr></table>John
36÷12=3 Connie has 3 times more marbles.</td></tr>
<tr><td>Fractions</td><td>Fraction Model (finding one part, given the whole)</td><td>Connie has 15 marbles. She gives 2/5 of them to John. How many marbles does she have left?</td><td><table><tr><td colspan="5">15</td></tr><tr><td>?</td><td>?</td><td>?</td><td>J</td><td>J</td></tr></table>15÷5=3. 3x3=9. Connie has 9 marbles left.</td></tr>
</table>

	Fraction Model (finding the whole, given one part)	Connie has some marbles. She gives John $\frac{1}{4}$ of her marbles and is left with 15. How many marbles did she have to start with?	 15÷3=5. 5x4=20. Connie started with 20 marbles.
	Fraction Model (finding one part, given another)	Connie has some marbles. She gives 8 to John and she keeps the other $\frac{3}{4}$. How many does she keep?	 8x3=24. Connie keeps 24 marbles.