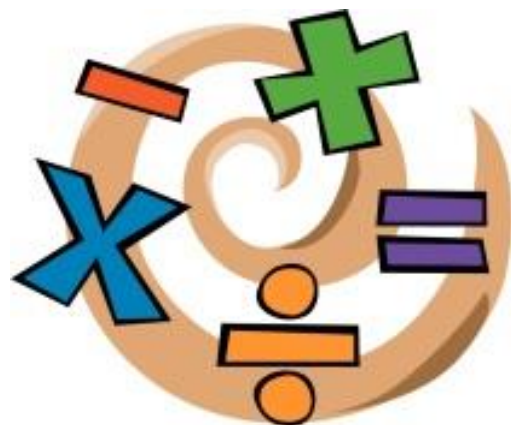# OULTON PRIMARY SCHOOL

Thinking for ourselves, caring for each other

Calculation Policy

Updated September 2016

Aims of Mathematics

The national curriculum for mathematics aims to ensure that all pupils:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.

- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language

- can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

End of year expectations for written methods:

	Addition	Subtraction	Multiplication	Division
Year 1	Read, write and interpret mathematical statements involving addition (+), subtraction (−) and equals (=) signs		Solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.	
Year 2	Add and subtract numbers using concrete objects, pictorial representations, and mentally (two-digit number and ones, two-digit number and tens, two two-digit numbers, three one-digit numbers) Solve problems with addition and subtraction: • using concrete objects and pictorial representations, including those involving numbers, quantities and measures • applying their increasing knowledge of mental and written methods *Recording addition and subtraction in columns supports place value and prepares for formal written methods with larger numbers*		Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.	
Year 3	Add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction. *Pupils use their understanding of place value and partitioning, and practise using columnar addition and subtraction with increasingly large numbers up to three digits to become fluent* **See Mathematics Appendix 1**		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 *Pupils develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written methods of short multiplication and division.* **See Mathematics Appendix 1**	

Year 4	Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate Solve problems involving decimals to two decimal places *Pupils continue to practise both mental methods and columnar addition and subtraction with increasingly large numbers to aid fluency* **See Mathematics Appendix 1**	Multiply two-digit and three-digit numbers by a one-digit number using formal written layout *Pupils practise to become fluent in the formal written method of short multiplication with exact answers* **See Mathematics Appendix 1**	Divide numbers up to 3 digits by a one-digit number using a formal written layout *Pupils practise to become fluent in the formal written method of short division with exact answers* **See Mathematics Appendix 1**
Year 5	Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction) Solve problems involving number up to three decimal places *Pupils practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency* **See Mathematics Appendix 1**	Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers *Pupils practise and extend their use of the formal written methods of short multiplication* **See Mathematics Appendix 1**	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 *Pupils practise and extend their use of the formal written methods of short division* **See Mathematics Appendix 1**
Year 6	Solve problems involving number up to three decimal places *Pupils practise addition and subtraction for larger numbers, using the formal written methods of columnar addition and subtraction.* **See Mathematics Appendix 1**	Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication Multiply one-digit numbers with up to two decimal places by whole numbers **See Mathematics Appendix 1**	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 Divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context Use written division methods in cases where the answer has up to two decimal places. **See Mathematics Appendix 1**

Mathematics Appendix 1: Examples of formal written methods for addition, subtraction, multiplication and division

This appendix sets out some examples of formal written methods for all four operations to illustrate the range of methods that could be taught. It is not intended to be an exhaustive list, nor is it intended to show progression in formal written methods. For example, the exact position of intermediate calculations (superscript and subscript digits) will vary depending on the method and format used.

For multiplication, some pupils may include an addition symbol when adding partial products. For division, some pupils may include a subtraction symbol when subtracting multiples of the divisor.

Addition and subtraction

789 + 642 becomes

```
    7  8  9
 +  6  4  2
 ----------
 1  4  3  1
    1  1
```

Answer: 1431

874 – 523 becomes

```
    8  7  4
 -  5  2  3
 ----------
    3  5  1
```

Answer: 351

932 – 457 becomes

```
    8  12  1
    9  ₃ 2
 -  4  5  7
 ----------
    4  7  5
```

Answer: 475

932 – 457 becomes

```
    9  3  2
 -  4  5  7
        5  6
 ----------
    4  7  5
```

Answer: 475

Short multiplication

24 × 6 becomes

```
       2  4
   ×      6
   --------
    1  4  4
       2
```

Answer: 144

342 × 7 becomes

```
       3  4  2
   ×         7
   -----------
    2  3  9  4
       2  1
```

Answer: 2394

2741 × 6 becomes

```
       2  7  4  1
   ×            6
   -------------
    1  6  4  4  6
          4  2
```

Answer: 16 446

Long multiplication

24 × 16 becomes

```
          2
       2  4
   ×   1  6
   --------
    2  4  0
    1  4  4
   --------
    3  8  4
```

Answer: 384

124 × 26 becomes

```
       1  2
    1  2  4
   ×    2  6
   ---------
 2  4  8  0
    7  4  4
 ---------
 3  2  2  4
    1  1
```

Answer: 3224

124 × 26 becomes

```
       1  2
    1  2  4
   ×    2  6
   ---------
    7  4  4
 2  4  8  0
 ---------
 3  2  2  4
    1  1
```

Answer: 3224

Short division

98 ÷ 7 becomes

```
       1  4
    ------
  7 | 9  ²8
```

Answer: 14

432 ÷ 5 becomes

```
          8  6  r 2
    --------
  5 | 4  ³3  2
```

Answer: 86 remainder 2

496 ÷ 11 becomes

```
          4   5  r 1
    --------
 1 1 | 4  ⁵9  6
```

Answer: $45\frac{1}{11}$

Long division

432 ÷ 15 becomes

```
           2  8   r 12
       --------
  1  5 | 4  3  2
         3  0  0
         ------
         1  3  2
         1  2  0
         ------
            1  2
```

Answer: 28 remainder 12

432 ÷ 15 becomes

```
           2  8
       --------
  1  5 | 4  3  2
         3  0  0    15×20
         ------
         1  3  2
         1  2  0    15×8
         ------
            1  2

         12  =  4
         ---    -
         15     5
```
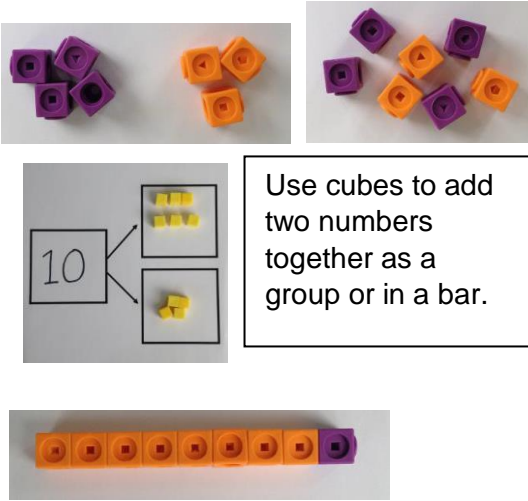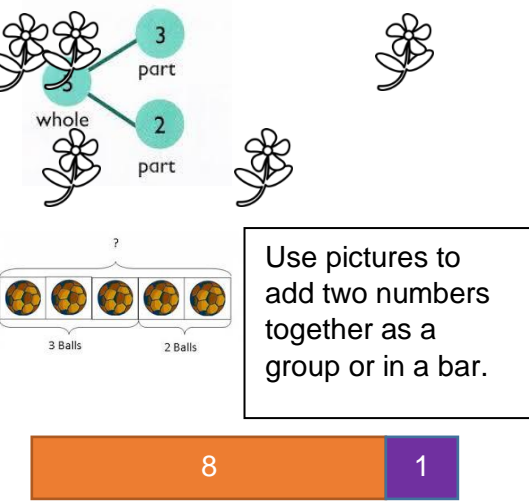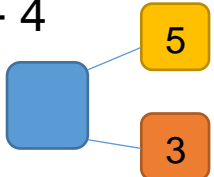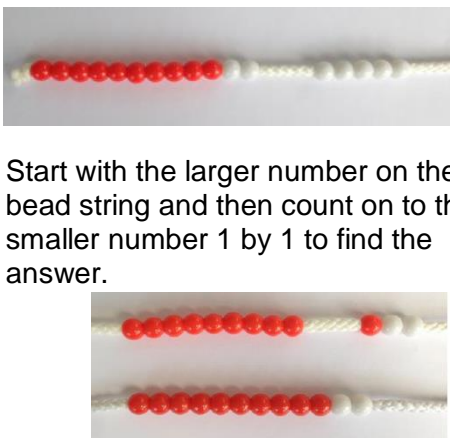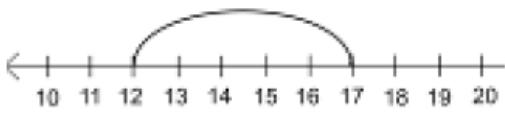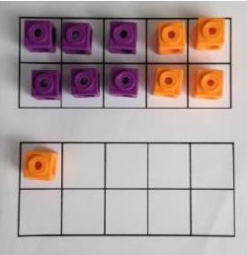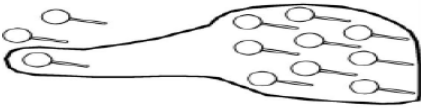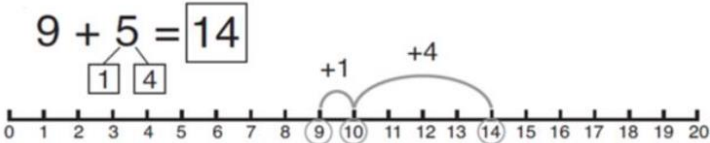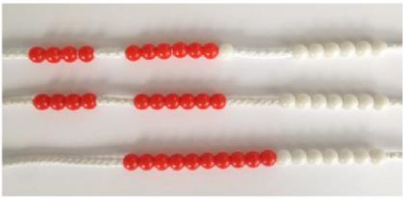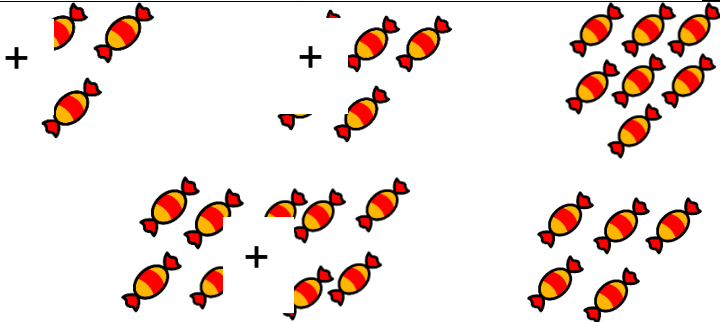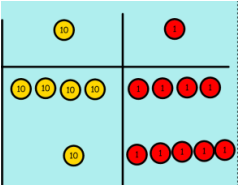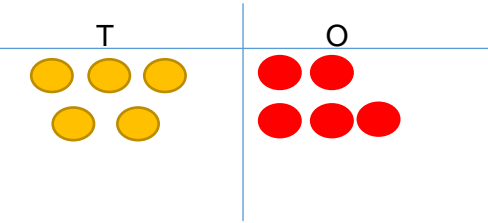
Answer: $28\frac{4}{5}$

432 ÷ 15 becomes
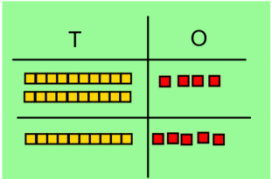
```
           2  8 · 8
       -----------
  1  5 | 4  3  2 · 0
         3  0
         ------
         1  3  2
         1  2  0
         ------
            1  2  0
            1  2  0
            ------
                  0
```
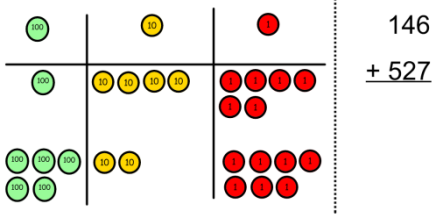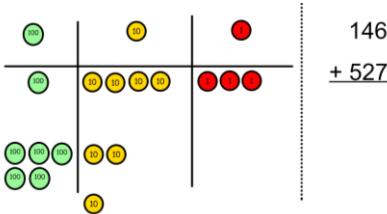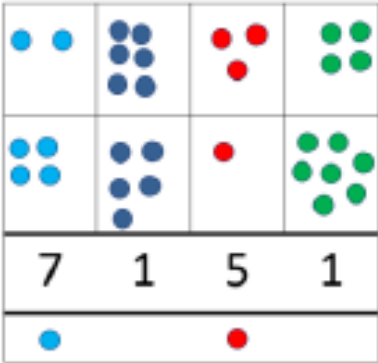
Answer: 28·8

Addition

Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	Use cubes to add two numbers together as a group or in a bar.	Use pictures to add two numbers together as a group or in a bar. 3 Balls 2 Balls 8 1	$4 + 3 = 7$ $10 = 6 + 4$ 5 3 Use the part-part whole diagram as shown above to move into the abstract.
Starting at the bigger number and counting on	Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.	$12 + 5 = 17$ 10 11 12 13 14 15 16 17 18 19 20 Start at the larger number on the number line and count on in ones or in one jump to find the answer.	$5 + 12 = 17$ Place the larger number in your head and count on the smaller number to find your answer.

Objective and Strategies	Concrete	Pictorial	Abstract
Regrouping to make 10.	6 + 5 = 11 Start with the bigger number and use the smaller number to make 10.	Use pictures or a number line. Regroup or partition the smaller number to make 10. $3 + 9 =$ $9 + 5 = \boxed{14}$ $\boxed{1}\ \boxed{4}$	7 + 4= 11 If I am at seven, how many more do I need to make 10. How many more do I add on now?
Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7. Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	+ + + Add together three groups of objects. Draw a picture to recombine the groups to make 10.	$4 + 7 + 6 = \boxed{10} + \boxed{7}$ 10 $= \boxed{17}$ Combine the two numbers that make 10 and then add on the remainder.
Column method- no regrouping	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. T O	Calculations 21 + 42 = 21 + 42

Objective and Strategies	Concrete	Pictorial	Abstract
Column method- regrouping	Make both numbers on a place value grid. 146 + 527 Add up the units and exchange 10 ones for one 10. 146 + 527 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding. 	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 536 + 85 621 1 1

This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100.

As children move on to decimals, money and decimal place value counters can be used to support learning.

As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here.

```
  72.8
+ 54.6
 127.4        £  2  3  .  5  9
  1 1      +  £     7  .  5  5
              £  3  1  .  1  4
                    1  1     1


   2  3  .  3  6  1
      9  .  0  8  0
   5  9  .  7  7  0
+  1  .  3  0  0
   9  3  .  5  1  1
   2  1     2
```
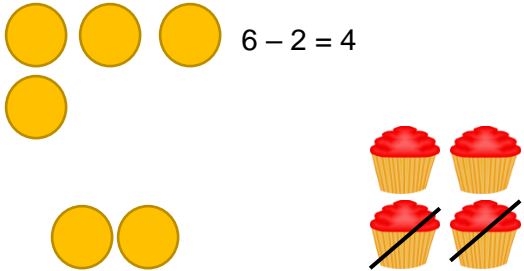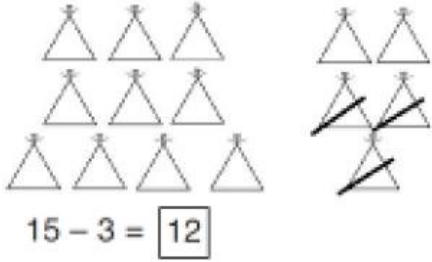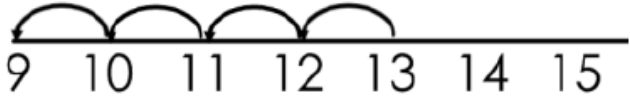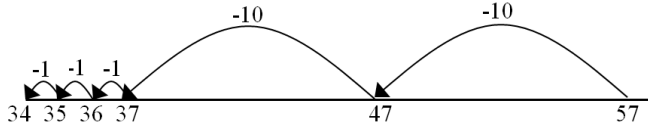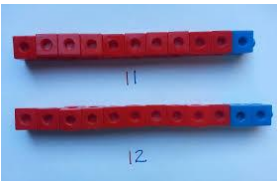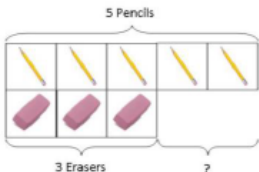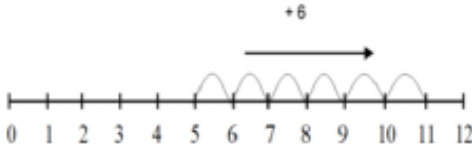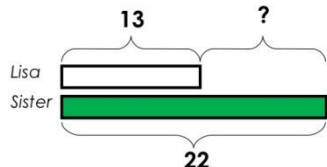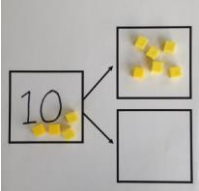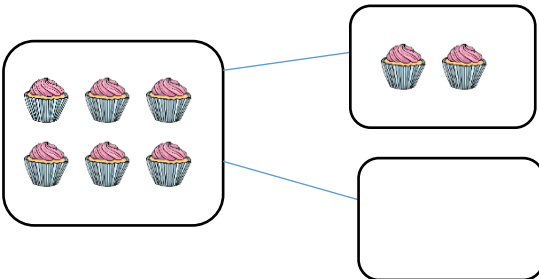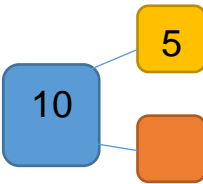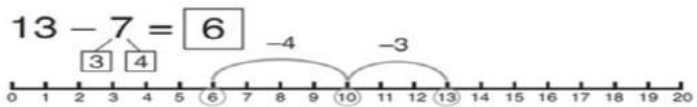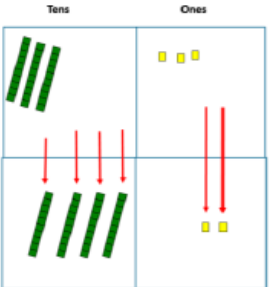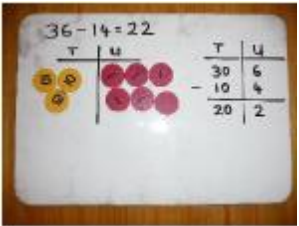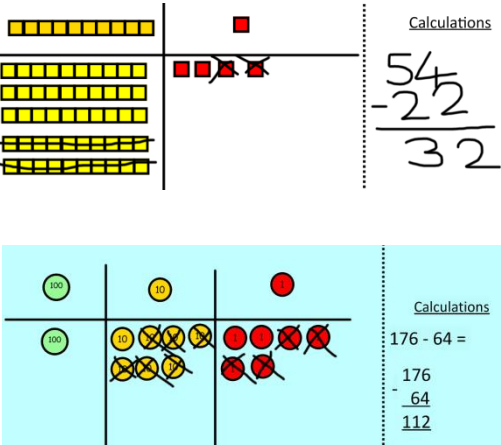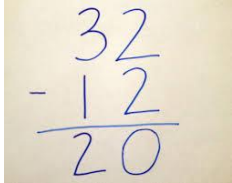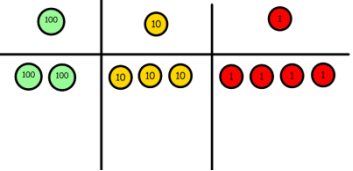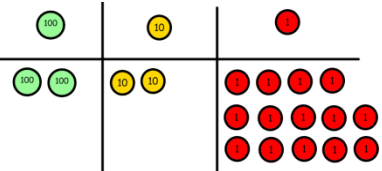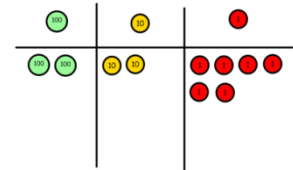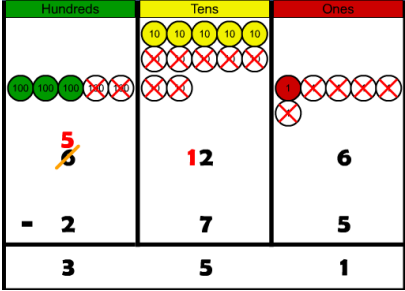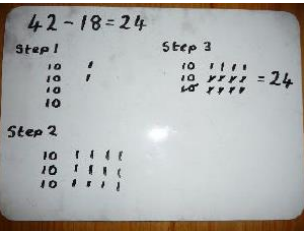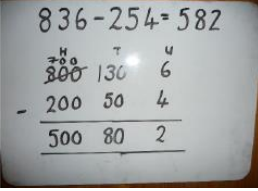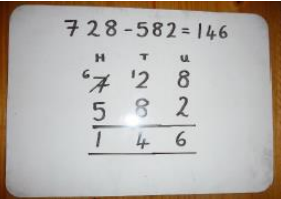
<u>Subtraction</u>

Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away. 6 – 2 = 4	Cross out drawn objects to show what has been taken away. 15 – 3 = 12	18 – 3 = 15 8 – 2 = 6
Counting back	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones. 13 – 4 Use counters and move them away from the group as you take them away counting backwards as you go.	Count back on a number line or number track 9 10 11 12 13 14 15 Start at the bigger number and count back the smaller number showing the jumps on the number line. -1 -1 -1 -10 -10 34 35 36 37 47 57 This can progress all the way to counting back using two 2 digit numbers.	Put 13 in your head, count back 4. What number are you at? Use your fingers to help.

Objective and Strategies	Concrete	Pictorial	Abstract
Find the difference	Compare amounts and objects to find the difference. Use cubes to build towers or make bars to find the difference Use basic bar models with items to find the difference 5 Pencils 3 Erasers ?	 +6 0 1 2 3 4 5 6 7 8 9 10 11 12 Count on to find the difference. Draw bars to find the difference between 2 numbers. **Comparison Bar Models** Lisa is 13 years old. Her sister is 22 years old. Find the difference in age between them. 13 ? Lisa Sister 22	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.
Part Part Whole Model	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =	Use a pictorial representation of objects to show the part part whole model. 	 5 10 Move to using numbers within the part whole model.

Objective and Strategies	Concrete	Pictorial	Abstract
Make 10	14 – 9 = Make 14 on the ten frame. Take away the four first to make 10 and then takeaway one more so you have taken away 5. You are left with the answer of 9.	 Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.	16 – 8= How many do we take off to reach the next 10? How many do we have left to take off?
Column method without regrouping	Use Base 10 to make the bigger number then take the smaller number away. Show how you partition numbers to subtract. Again make the larger number first.	Draw the Base 10 or place value counters alongside the written calculation to help to show working. 	47 – 24 = 23 $\begin{array}{r} 40+7 \\ -20+4 \\ \hline 20+3 \end{array}$ This will lead to a clear written column subtraction. $\begin{array}{r} 32 \\ -12 \\ \hline 20 \end{array}$

Objective and Strategies	Concrete	Pictorial	Abstract
Column method with regrouping	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters Calculations 234 - 88 Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones. Calculations 234 - 88 Now I can subtract my ones. Calculations 234 - 88	Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make. When confident, children can find their own way to record the exchange/regrouping. Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.	$836 - 254 = 582$ Children can start their formal written method by partitioning the number into clear place value columns. $728 - 582 = 146$ Moving forward the children use a more compact method. This will lead to an understanding of subtracting any number including decimals.

Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.

Calculations

234
- 88
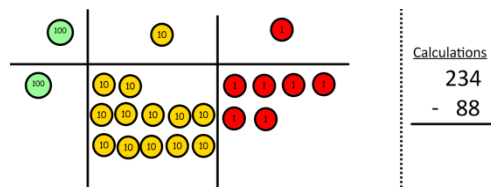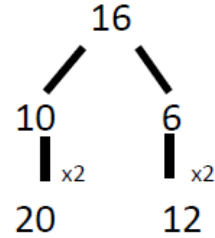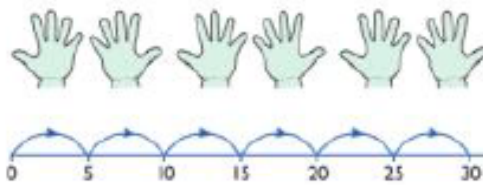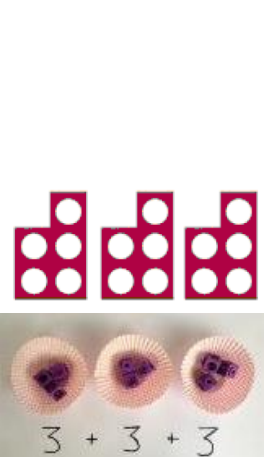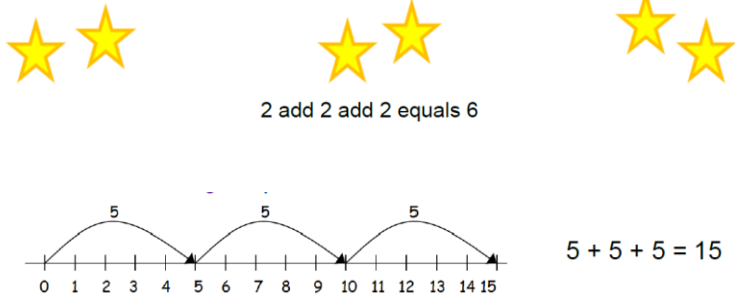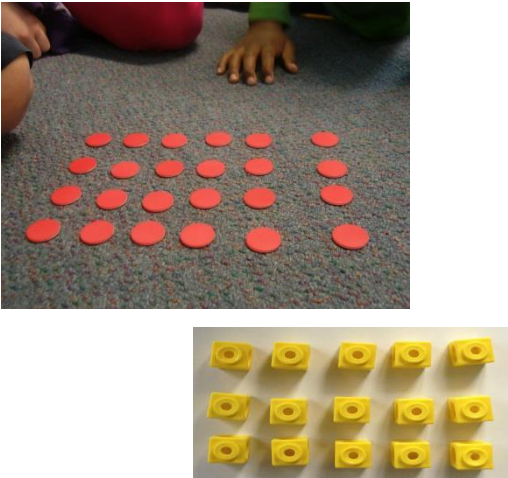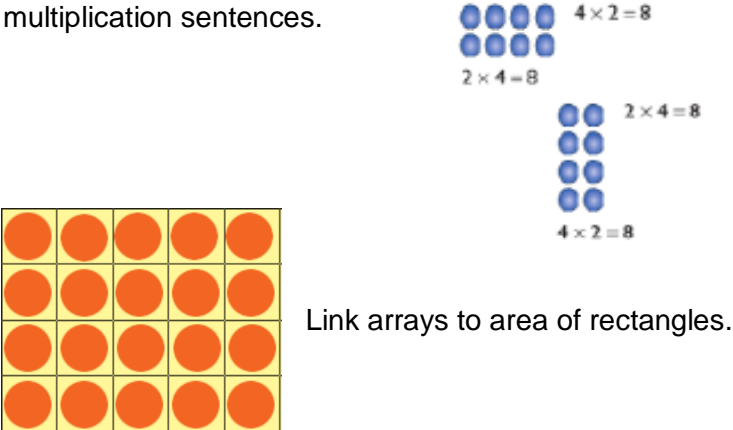
Now I can take away eight tens and complete my subtraction
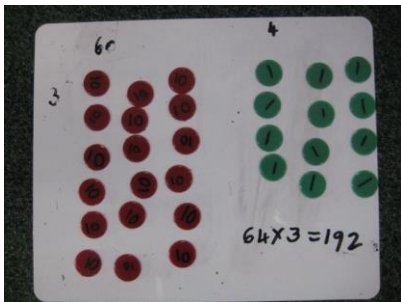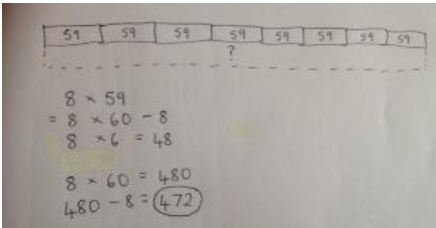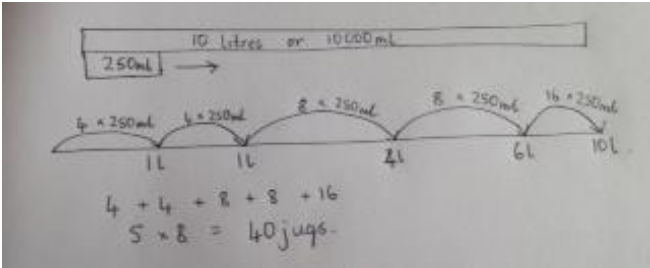
Calculations

234
- 88
146
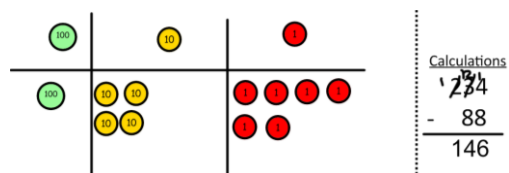
Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.
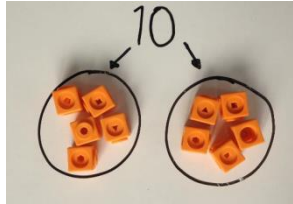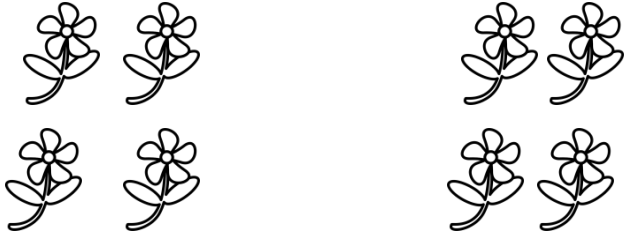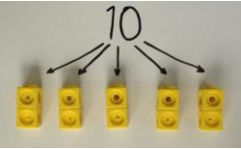
Multiplication
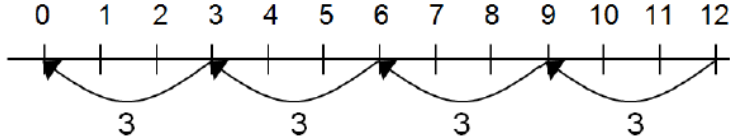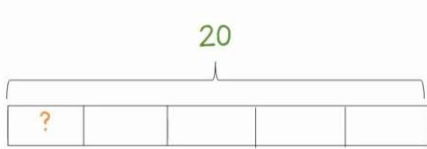
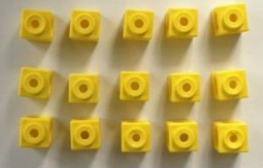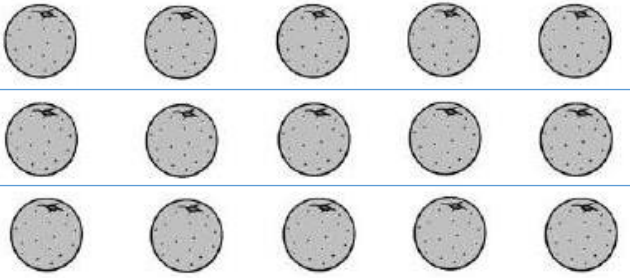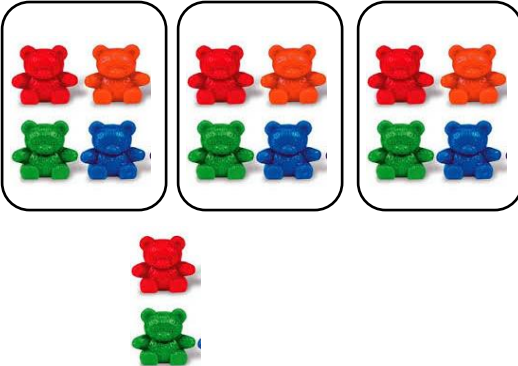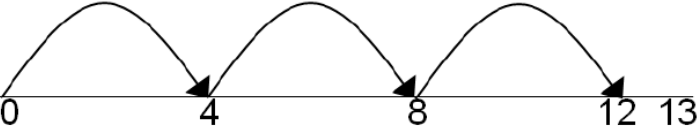| Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	Use practical activities to show how to double a number. double 4 is 8 $4 \times 2 = 8$	Draw pictures to show how to double a number. Double 4 is 8	16 10 6 x2 x2 20 12 Partition a number and then double each part before recombining it back together.
Counting in multiples	Count in multiples supported by concrete objects in equal groups.	Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25 , 30

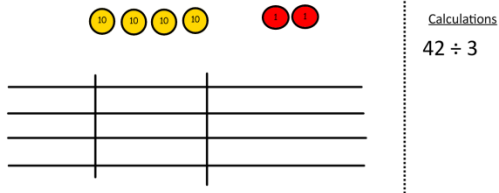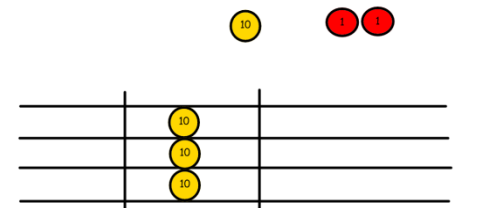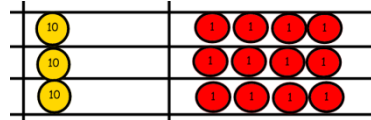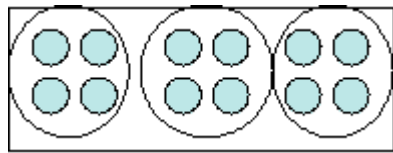| Objective and Strategies	Concrete	Pictorial	Abstract
Repeated addition	Use different objects to add equal groups. 3 + 3 + 3	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there? 2 add 2 add 2 equals 6 5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures. 2 + 2 + 2 + 2 + 2 = 10
Arrays- showing commutative multiplication	Create arrays using counters/ cubes to show multiplication sentences.	Draw arrays in different rotations to find **commutative** multiplication sentences. $4 \times 2 = 8$ $2 \times 4 = 8$ $2 \times 4 = 8$ $4 \times 2 = 8$ Link arrays to area of rectangles.	Use an array to write multiplication sentences and reinforce repeated addition. 5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15
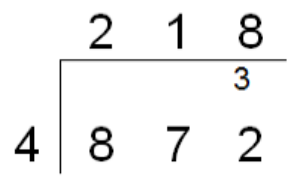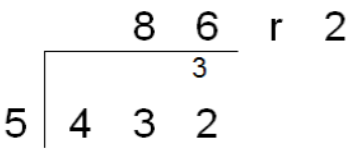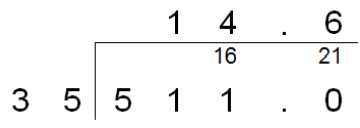
Objective and Strategies	Concrete	Pictorial	Abstract
Grid Method	Show the link with arrays to first introduce the grid method. | x	10	3 | with 4 rows of red dots — 4 rows of 10, 4 rows of 3 Move on to using Base 10 to move towards a more compact method. | x	T	U	— 4 rows of 13 Move on to place value counters to show how we are finding groups of a number. We are multiplying by 4 so we need 4 rows. Calculations 4 x 126 Fill each row with 126. Calculations 4 x 126 Add up each column, starting with the ones making any exchanges needed. Then you have your answer.	Children can represent the work they have done with place value counters in a way that they understand. They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below. 24 x 3 = 72 | X	20	4
3	00 00 0 0 00 = 60	0000 0000 0000 = 12	 60 + 12 / 72	Start with multiplying by one digit numbers and showing the clear addition alongside the grid. 	×	30	5
---	---	---
7	210	35	 210 + 35 = 245 Moving forward, multiply by a 2 digit number showing the different rows within the grid method. 		10	8
---	---	---
10	100	80
3	30	24	 	X	1000	300	40	2
---	---	---	---	---
10	10000	3000	400	20
8	8000	2400	320	16	

Objective and Strategies	Concrete	Pictorial	Abstract
Column multiplication	Children can continue to be supported by place value counters at the stage of multiplication. It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.	Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods. 	Start with long multiplication, reminding the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer. This moves to the more compact method.

Division

Objective and Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups	I have 10 cubes, can you share them equally in 2 groups?	Children use pictures or shapes to share quantities. $$8 \div 2 = 4$$	Share 9 buns between three people. $$9 \div 3 = 3$$
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding. $$96 \div 3 = 32$$	Use a number line to show jumps in groups. The number of jumps equals the number of groups. Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group. 20 $$20 \div 5 = ?$$ $$5 \times ? = 20$$	$$28 \div 7 = 4$$ Divide 28 into 7 groups. How many are in each group?

| Objective and Strategies	Concrete	Pictorial	Abstract
Division within arrays	Link division to multiplication by creating an array and thinking about the number sentences that can be created. Eg 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the inverse of multiplication and division sentences by creating four linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7
Division with a remainder	14 ÷ 3 = Divide objects between groups and see how much is left over	Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder. 0 4 8 12 13 Draw dots and group them to divide an amount and clearly show a remainder. remainder 2	Complete written divisions and show the remainder using r. 29 ÷ 8 = 3 REMAINDER 5 ↑ ↑ ↑ ↑ dividend divisor quotient remainder

Objective and Strategies	Concrete	Pictorial	Abstract
Short division	Use place value counters to divide using the bus stop method alongside Calculations 42 ÷ 3 42 ÷ 3= Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over. We exchange this ten for ten ones and then share the ones equally among the groups. We look how much in 1 group so the answer is 14.	Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups. Encourage them to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainder. 2 1 8 3 4 8 7 2 Move onto divisions with a remainder. 8 6 r 2 3 5 4 3 2 Finally move into decimal places to divide the total accurately. 1 4 . 6 16 21 3 5 5 1 1 . 0

Fractions and Decimals

Solve... Order the fractions $\frac{1}{3}, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}$

Model

$\frac{1}{3}$
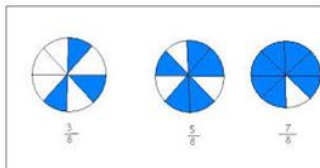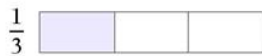
Calculations

Show me $\frac{1}{4}$

Which is bigger, $\frac{1}{3}$ or $\frac{1}{6}$
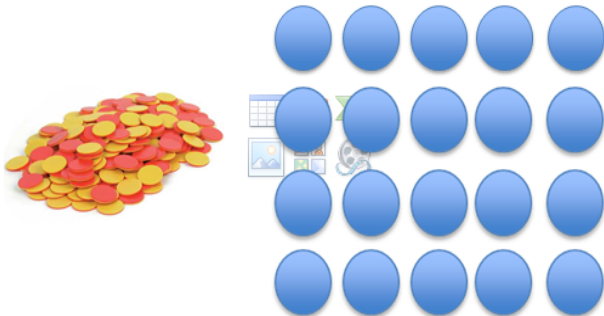
Solve... Is $\frac{1}{2}$ always the same?

Model

$\frac{1}{5}$

$\frac{1}{5}$

Calculations

How many ways can you represent $\frac{1}{5}$?

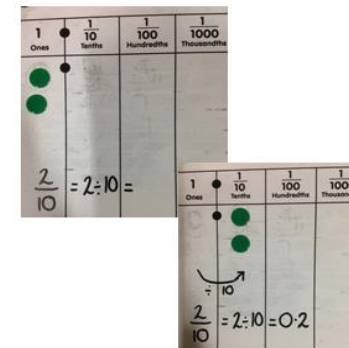## Solve..... Find $\frac{3}{5}$ of 20

Model

Calculations

$20 \div 5 = 4$

$4 \times 3 = 12$

Solve... Convert $\frac{2}{10}$ into a decimal

Model

$\frac{2}{10} = 2 \div 10 =$

$\frac{2}{10} = 2 \div 10 = 0.2$

Calculations

Prove ¼ = 0.25

Show $\frac{4}{10} = 0.4$

Prove $\frac{35}{100} = 0.35$