Multiplication and Division

Mathematics Calculation Policy

Introduction:

The mathematics curriculum at Sandy Hill has been designed to ensure that children possess the skills and knowledge that will affect them positively in their lives. Concepts have been carefully sequenced to enable learners to make connections, building upon prior knowledge. At the heart of the curriculum, driven throughout each academic year are fundamental fluency/arithmetic skills.

Aims:

- Ensure that every child possesses key fluency skills to enhance their self-confidence and enjoyment of mathematics in order to develop their understanding of the world.
- Develop pupils' reasoning skills using precise mathematical vocabulary
- Build pupils' understanding through applying their skills to problem-solving activities and real-life links.

Rationale:

This calculation policy exists as a direct result of careful collaborative and evidence-based curriculum planning, linked closely with direct experience and knowledge of how children learn best within mathematics. Through the systems we implement, we aim to engineer mathematical success.

As a school, arithmetic is given its own (separate) dedicated practice time within the school day. As an established system within the school, we recognise that children (including those with SEND) benefit from having simple, efficient and effective strategies (procedural knowledge) to help them solve mathematical problems. Coupled with the most vital maths facts (declarative knowledge) that are rehearsed systematically, pupils' working memory is not overloaded, pupils experience success, gaining enjoyment and self-confidence. (OFSTED Research Review Series, May 2021).

This calculation policy aims to identify the key progressions across the school, identifying the images pupils will experience (White Rose linked) and the procedural knowledge required at each stage of the mathematics journey.

Images to Support Mathematical Understanding:

White Rose Is used by the school to inform planning and support with small steps progression. The images below are used to support the teaching and learning of mathematics.

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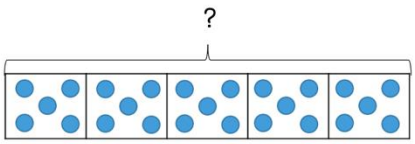
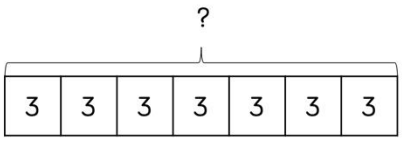
Bar Model

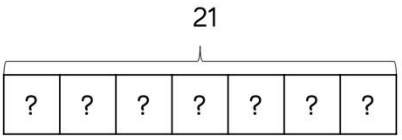


$5 \times 5 = 25$

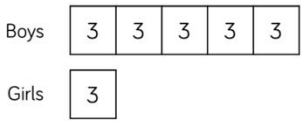


$3 \times 7 = 21$

$7 \times 3 = 21$



$21 \div 7 = 3$



Benefits

Children can use the single bar model to represent multiplication as repeated addition. They could use counters, cubes or dots within the bar model to support calculation before moving on to placing digits into the bar model to represent the multiplication.

Division can be represented by showing the total of the bar model and then dividing the bar model into equal groups.

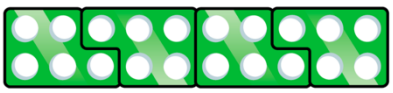
It is important when solving word problems that the bar model represents the problem.

Sometimes, children may look at scaling problems. In this case, more than one bar model is useful to represent this type of problem, e.g. There are 3 girls in a group. There are 5 times more boys than girls. How many boys are there?
The multiple bar model provides an opportunity to compare the groups.

Number Shapes

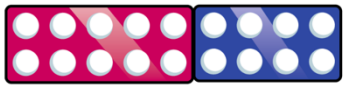
$5 \times 4 = 20$

$4 \times 5 = 20$

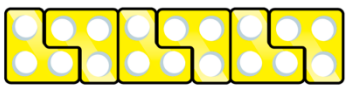


$5 \times 4 = 20$

$4 \times 5 = 20$



$18 \div 3 = 6$



Benefits

Number shapes support children's understanding of multiplication as repeated addition.

Children can build multiplications in a row using the number shapes. When using odd numbers, encourage children to interlock the shapes so there are no gaps in the row. They can then use the tens number shapes along with other necessary shapes over the top of the row to check the total. Using the number shapes in multiplication can support children in discovering patterns of multiplication e.g. odd × odd = even, odd × even = odd, even × even = even.

When dividing, number shapes support children's understanding of division as grouping. Children make the number they are dividing and then place the number shape they are dividing by over the top of the number to find how many groups of the number there are altogether e.g. There are 6 groups of 3 in 18.

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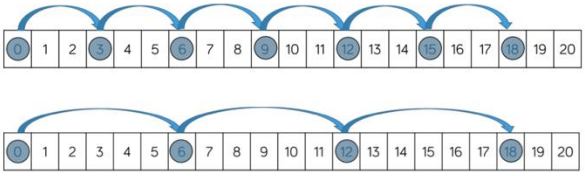
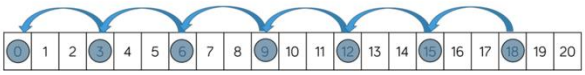
Number Tracks



$6 \times 3 = 18$
$3 \times 6 = 18$



$18 \div 3 = 6$

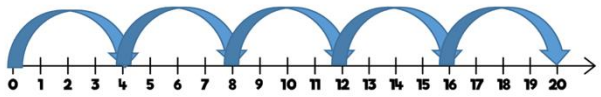
Benefits

Number tracks are useful to support children to count in multiples, forwards and backwards. Moving counters or cubes along the number track can support children to keep track of their counting. Translucent counters help children to see the number they have landed on whilst counting.

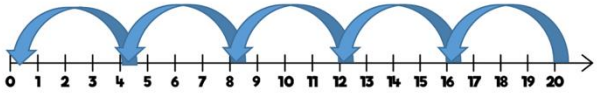
When multiplying, children place their counter on 0 to start and then count on to find the product of the numbers.
When dividing, children place their counter on the number they are dividing and the count back in jumps of the number they are dividing by until they reach 0.
Children record how many jumps they have made to find the answer to the division.

Number tracks can be useful with smaller multiples but when reaching larger numbers they can become less efficient.

Number Lines (labelled)



$4 \times 5 = 20$
$5 \times 4 = 20$



$20 \div 4 = 5$

Benefits

Labelled number lines are useful to support children to count in multiples, forwards and backwards as well as calculating single-digit multiplications.

When multiplying, children start at 0 and then count on to find the product of the numbers.
When dividing, start at the number they are dividing and the count back in jumps of the number they are dividing by until they reach 0.
Children record how many jumps they have made to find the answer to the division.

Labelled number lines can be useful with smaller multiples, however they become inefficient as numbers become larger due to the required size of the number line.

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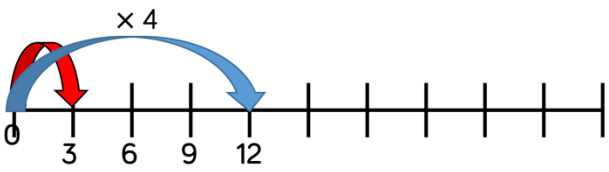
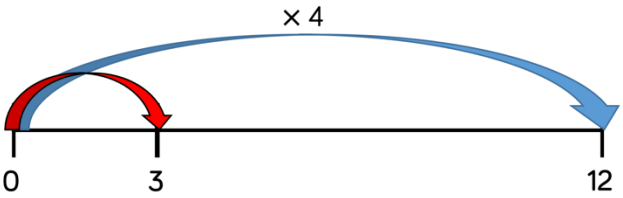
Number Lines (blank)



A red car travels 3 miles.
A blue car 4 times further.
How far does the blue car travel?



A blue car travels 12 miles.
A red car 4 times less.
How far does the red car travel?

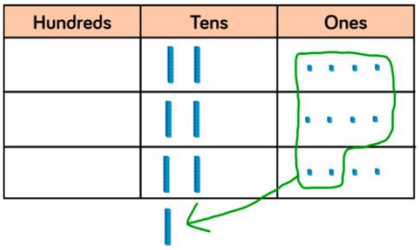
Benefits

Children can use blank number lines to represent scaling as multiplication or division.

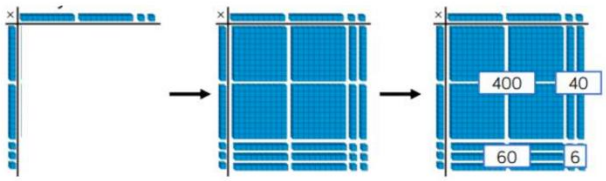
Blank number lines with intervals can support children to represent scaling accurately. Children can label intervals with multiples to calculate scaling problems.

Blank number lines without intervals can also be used for children to represent scaling.

Base 10/Dienes (multiplication)



$$\begin{array}{r} 24 \\ \times\ 3 \\ \hline 72 \\ \hline 1 \end{array}$$



Benefits

Using Base 10 or Dienes is an effective way to support children's understanding of column multiplication. It is important that children write out their calculation alongside the equipment so they can see how the concrete and written representations match.

As numbers become larger in multiplication or the amounts of groups becomes higher, Base 10 / Dienes becomes less efficient due to the amount of equipment and number of exchanges needed.

Base 10 also supports the area model of multiplication well. Children use the equipment to build the number in a rectangular shape which they then find the area of by calculating the total value of the pieces This area model can be linked to the grid method or the formal column method of multiplying 2-digits by 2-digits.

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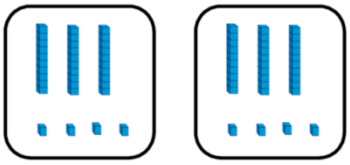
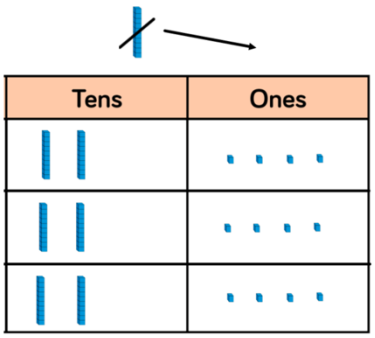
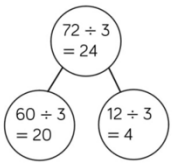
Base 10/Dienes (division)



$68 \div 2 = 34$



$72 \div 3 = 24$



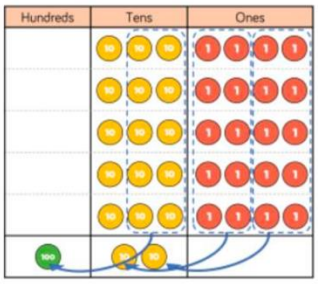
Benefits

Using Base 10 or Dienes is an effective way to support children's understanding of division.

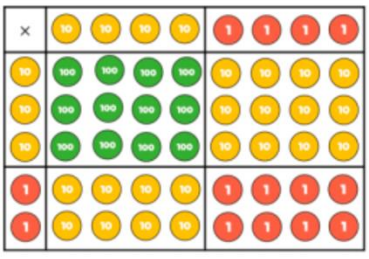
When numbers become larger, it can be an effective way to move children from representing numbers as ones towards representing them as tens and ones in order to divide. Children can then share the Base 10/ Dienes between different groups e.g. by drawing circles or by rows on a place value grid.

When they are sharing, children start with the larger place value and work from left to right. If there are any left in a column, they exchange e.g. one ten for ten ones. When recording, encourage children to use the part-whole model so they can consider how the number has been partitioned in order to divide. This will support them with mental methods.

Place Value Counters (multiplication)



$$\begin{array}{r} 34 \\ \times\ 5 \\ \hline 170 \\ \hline 1\ 2 \end{array}$$



$$\begin{array}{r} 44 \\ \times\ 32 \\ \hline 8 \\ 80 \\ 120 \\ +\ 1200 \\ \hline 1408 \end{array}$$

Benefits

Using place value counters is an effective way to support children's understanding of column multiplication. It is important that children write out their calculation alongside the equipment so they can see how the concrete and written match.

As numbers become larger in multiplication or the amounts of groups becomes higher, Base 10 / Dienes becomes less efficient due to the amount of equipment and number of exchanges needed The counters should be used to support the understanding of the written method rather than support the arithmetic.

Place value counters also support the area model of multiplication well. Children can see how to multiply 2-digit numbers by 2-digit numbers.

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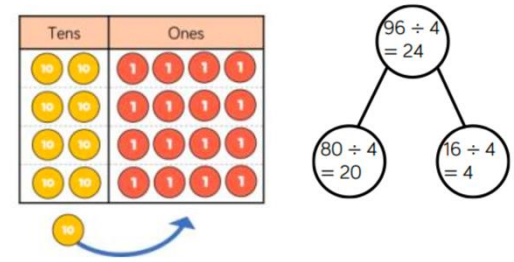
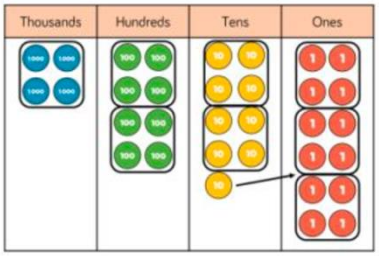
Place Value Counters (division)





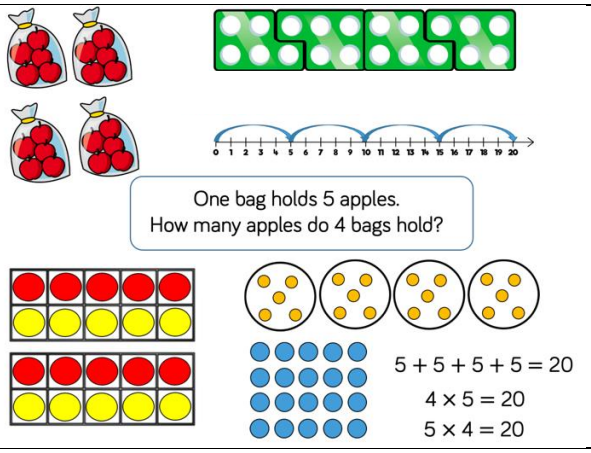
$$4\overline{)4892}^{\,1}$$
$$1223$$

Benefits

Using place value counters is an effective way to support children's understanding of division.

When working with smaller numbers, children can use place value counters to share between groups. They start by sharing the larger place value column and work from left to right. If there are any counters left over once they have been shared, they exchange the counter e.g. exchange one ten for ten ones. This method can be linked to the part-whole model to support children to show their thinking.

Place value counters also support children's understanding of short division by grouping the counters rather than sharing them. Children work from left to right through the place value columns and group the counters in the number they are dividing by. If there are any counters left over after they have been grouped, they exchange the counter e.g. exchange one hundred for ten tens.

Multiplication			
Year Group	**Learning Area**	**Procedural Knowledge**	**Rationale**
Year 1 and 2	Solve 1 step problems using multiplication		Children represent multiplication as repeated addition in many different ways. In Year 1, children use concrete and pictorial representations to solve problems. They are not expected to record multiplication formally. In Year 2, children are introduced to the multiplication symbol.

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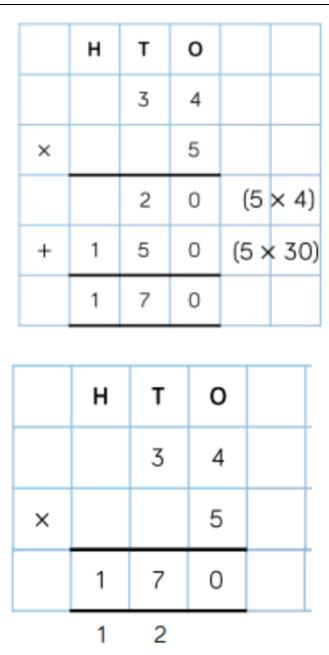
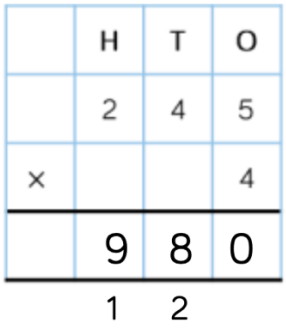
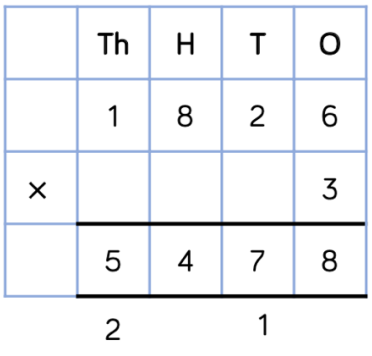
Year 3 and 4	Multiply 2 digits by 1 digit		Prioritise the short multiplication for all pupils to reduce cognitive overload. It is important that children understand the value of the digits. Clear modelling needed for place value and exchanging. The expanded approach above can be used to show the mathematics behind the method.
Year 4	Multiply 3 digits by 1 digit		When moving to 3- digit by 1-digit multiplication, encourage children to move towards the short, formal written method. This is further opportunity for children to recall times tables knowledge.
Year 5	Multiply 4 digits by 1 digit		Continue to encourage the use of the short, formal written method. This is further opportunity for children to recall times tables knowledge.

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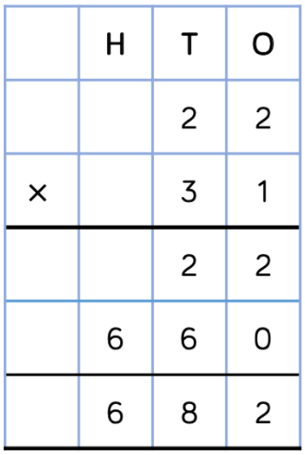
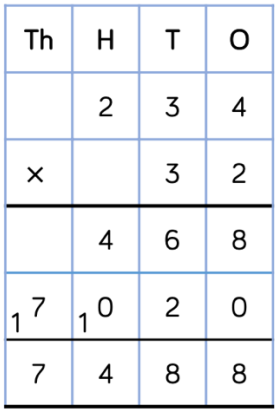
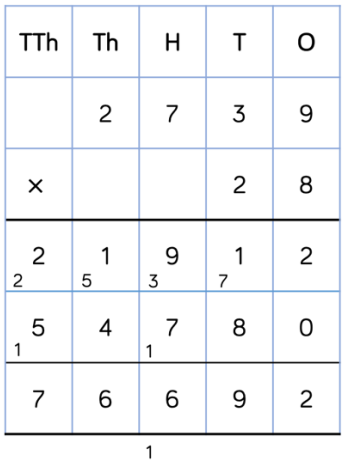
Year 5	Multiply 2 digits by 2 digits		When multiplying a multi-digit number by 2-digits, use the formal written multiplication approach building upon knowledge of multiplying by 1 digit. Ensure the children know that they need to use a place holder as they are multiplying by a multiple of 10. Exchange numbers below.
Year 5	Multiply 3 digits by 2 digits		When multiplying a multi-digit number by 2-digits, use the formal written multiplication approach building upon knowledge of multiplying by 1 digit. Ensure the children know that they need to use a place holder as they are multiplying by a multiple of 10. Exchange numbers below.
Year 5 and 6	Multiply 4 digits by 2 digits		When multiplying a multi-digit number by 2-digits, use the formal written multiplication approach building upon knowledge of multiplying by 1 digit. Ensure the children know that they need to use a place holder as they are multiplying by a multiple of 10. Exchange numbers below.

Division

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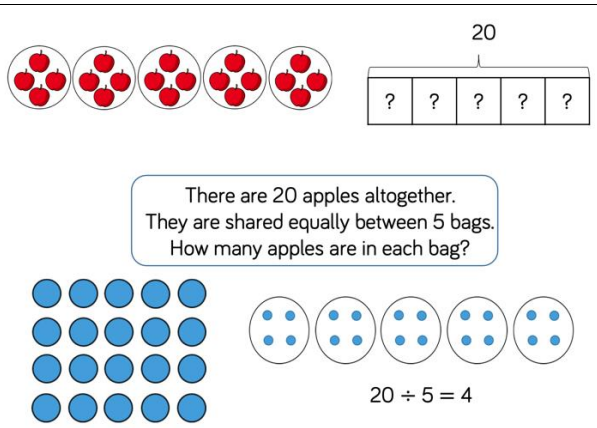
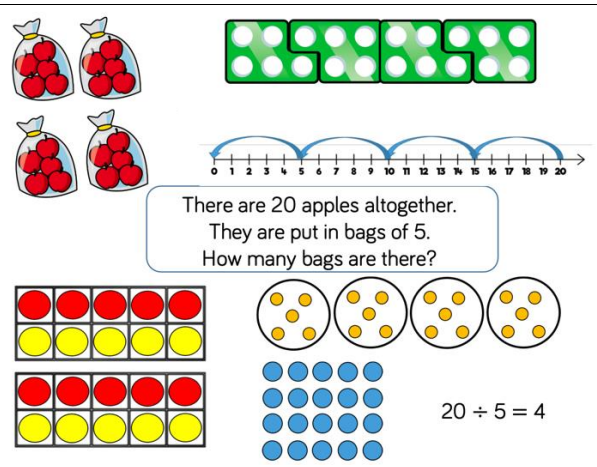
Year 1 and 2	Solve 1 step division problems (sharing) – linked to fractions		Children solve problems by sharing amounts into equal groups. In Year 1, children use concrete and pictorial representations to solve problems. They are not expected to record division formally. In Year 2, children are introduced to the division symbol.
Year 1 and 2	Solve 1 step division problems (grouping) – linked to fractions		Children solve problems by grouping and counting the number of groups. Grouping encourages children to count in multiples and links to repeated subtraction on a number line. They can use concrete representations in fixed groups such as number shapes which helps to show the link between multiplication and division.

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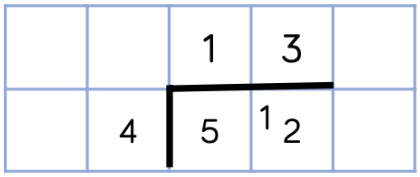
Year 3, 4, 5 and 6	Sharing with and without exchange		Starting without exchange, move towards exchanging. This method should not be used for numbers within times tables range. When using the short division method, children use grouping. Starting with the largest place value, they group by the divisor. If pupils can recall times tables facts, they can list multiples or use resources such as base ten.
Year 6	Dividing multi-digit numbers by 2 digits	14.6 16 21 35 | 511.0 30+5= 35 60 +10= 70 90 +15= 105 120 +20= 140 150 +25=175 180 +30= 210 as far as needed.	Count in 35s by partitioning the numbers. Count in 30s and 5s using times tables knowledge. This approach is used instead of the chunking method to reduce cognitive load.
Fractions and Miscellaneous			
Year 1 and 2	Fractions of an amount	Find one quarter of 20	Recognise that one quarter means four parts or half means two

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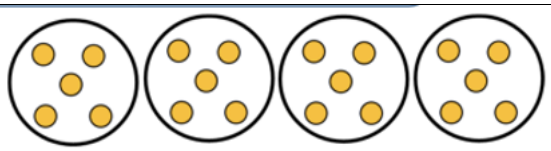
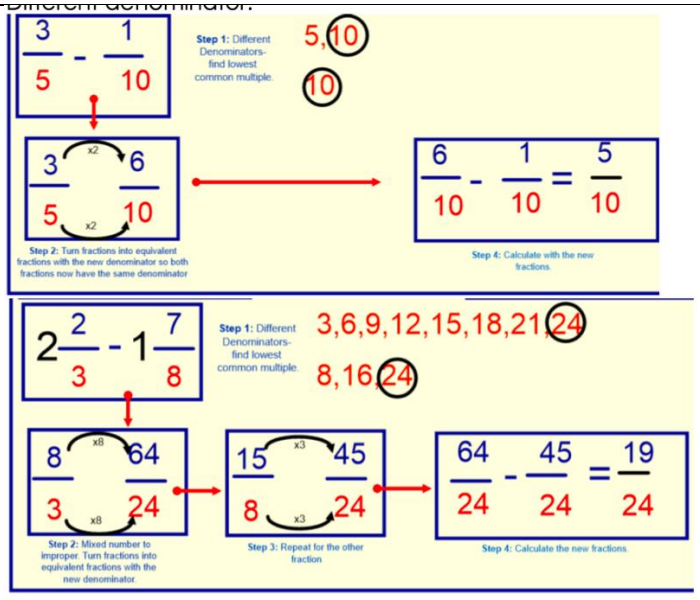
			parts. Use division knowledge to share between the number of groups.
Year 3 and 4	Adding and subtracting fractions with the same denominator	$\frac{2}{9}+\frac{5}{9}=\frac{7}{9}$ $\frac{9}{12}+\frac{4}{12}$ $=\frac{13}{12}=1\frac{1}{12}$	It is important that children understand that the whole is the denominator. The denominator stays the same throughout the addition or subtraction. The numerators require the addition or subtraction. If the top number is now larger after an addition, it means it is now worth more than 1 so could be expressed as either an improper or mixed number fraction.
Year 5 and 6	Adding and subtracting fractions with different denominators		Application of times knowledge to find the lowest common multiple When it is mixed number, it should be converted into improper prior to calculating. If an answer is improper it should be converted back to improper.

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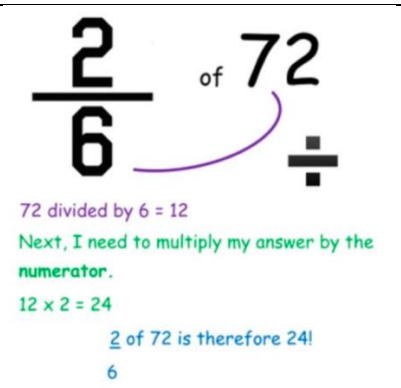
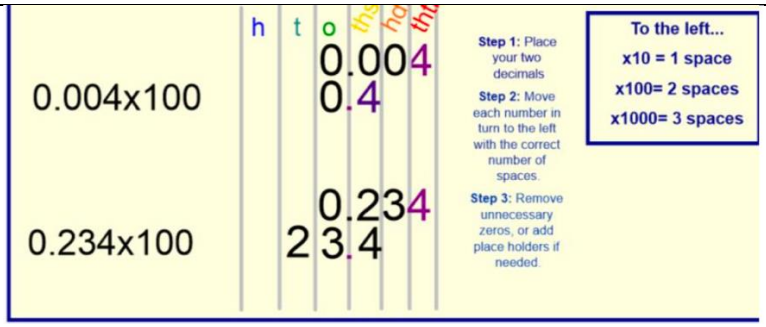
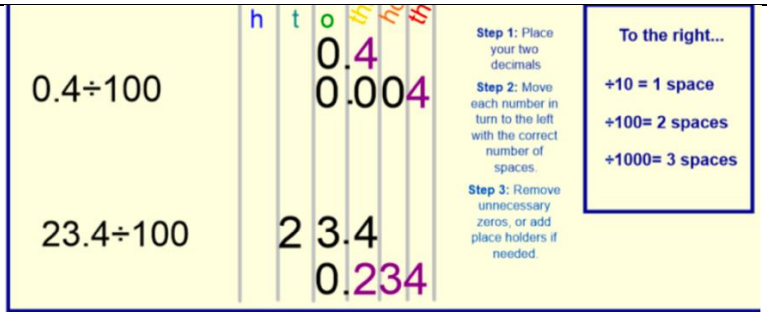
Year 3 to 6	Fraction of an amount		Children need to apply their knowledge of numerators and denominators. Divide the whole by the denominator and then times by the numerator. In Year 6, the 'of' is often represented as a 'X'
Year 3 to 6	Multiplying by 10, 100 or 1000		It is important that children use their knowledge of place value to solve these equations. As shown by the representations, each space that is moved to the left is another time it is multiplied by 10.
Year 3 to 6	Dividing by 10, 100 or 1000		It is important that children use their knowledge of place value to solve these equations. As shown by the representations, each space that is moved to the right is another time it is divided by 10.

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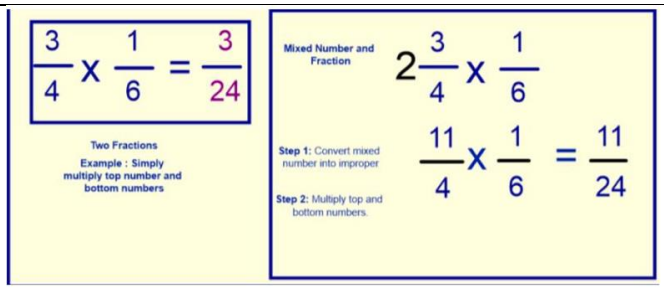
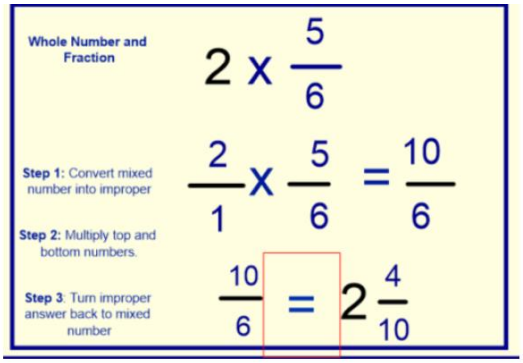
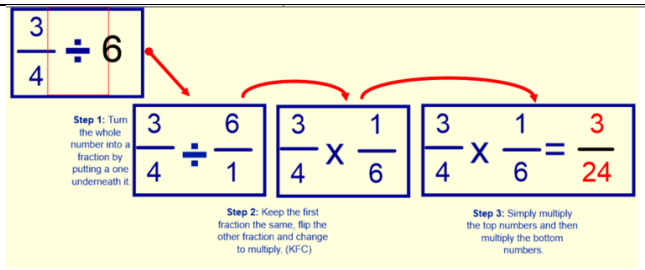
Year 5 and 6	Multiplying Fractions	 	Application of times knowledge. When it is mixed number, it should be converted into improper prior to calculating. If an answer is improper it should be converted back to improper.
Year 6	Dividing Fractions		KFC is a memorable way of children remembering the steps to dividing fractions. Remember that the larger the denominator the smaller the parts. When parts are divided (split) they become smaller which means the denominator is multiplied.

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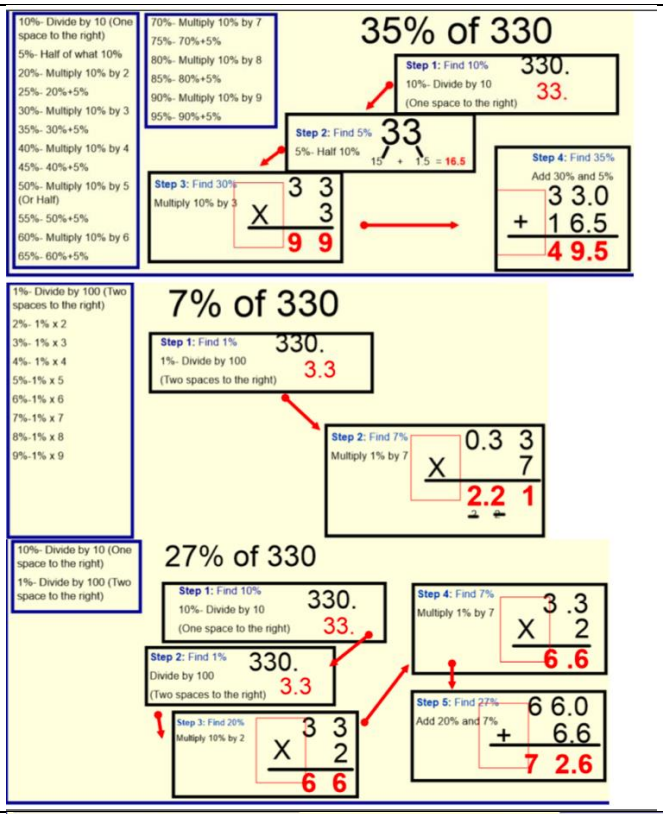
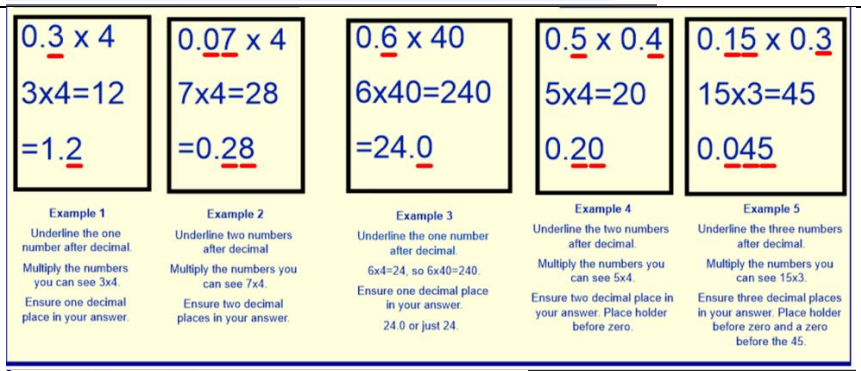
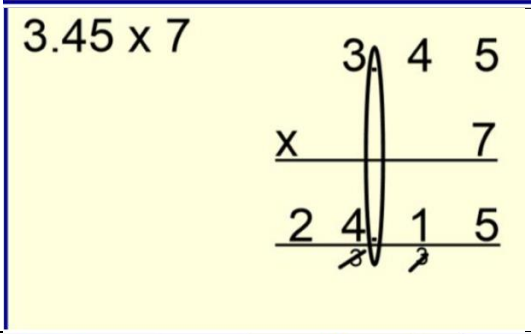
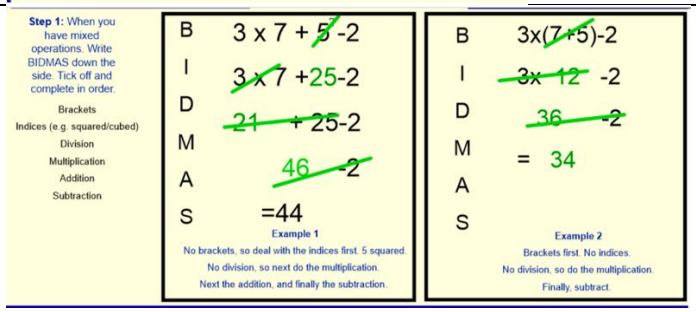
Year 6	Percentages		Children need to know that 10% is the golden percentage. This is found by dividing by 10.
Year 6	Multiplying Decimals	 	Children need to apply their knowledge or times tables.
Year 6	Order of Operations		Children must know the order of operations in order to reach the correct outcome. It is important to work in a methodical and

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			systematic manner.