Year 6

Year 6 - Autumn 1

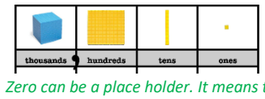
National Curriculum Milestones

Number: Place Value
Pupils should be taught to:
- Read, write, order and compare numbers up to 10,000,000 and determine the value of each digit
- Round any whole number to a required degree of accuracy
- Use negative numbers in context, and calculate intervals across zero
- Solve number and practical problems that involve all of the above.
- Pupils use the whole number system, including saying, reading and writing numbers accurately.

Number: Addition and Subtraction
Pupils should be taught to:
- Perform mental calculations, including with mixed operations and large numbers
- Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy

Geometry: Angles and Properties of Shapes
Pupils should be taught to:
- Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles.
- Draw 2D shapes using given dimensions and angles
- Recognise, describe and build simple 3D shapes, including making nets
- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons
- Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius

Revisited knowledge
New knowledge

Domains	**Declarative Knowledge** (substantive knowledge)	**Procedural Knowledge** (disciplinary knowledge)	**Conditional Knowledge** (knowing when and why)
Place Value	**Counting** Children need to know that… • *We can count in multiples (adding the same amount each time) (Year 1)* • *We can count forwards or backwards from any point (Year 1)* • *The counting sequences for multiples of 0,1,2,3,4,5,6,7,8,9,10,11 and 12 and their associated divisibility rules. (Year 4)* • *The counting sequences for multiples of 25, 50, 100 and 1000. (Year 4)* • Powers of 10 are any integer powers of the number 10. Powers of 10 include 10, 100, 1,000, 10,000, 100,000 and 1,000,000. **Representing Number** Children need to know that… • *All numbers have meaning. A number is a value that represents quantity. Each number has a name. Numbers can be represented in digits/numerals or words (KS1).* • *A digit is a single symbol used to represent a value within a number (KS1).* • *The position of this digit tells us its value (Year 1,2,3,4):*  • *Zero can be a place holder. It means there is no value in a place. (Year 3)* • *Numbers can be represented in different ways, e.g. using resources, pictorial representations and abstract representations (including objects, pictures, money and number lines). (Year 2)* • *Partitioning means to split a number into smaller parts. (KS1)*	**Counting** Children need to know how… • *To count in ones to and across 100 from a given number (Year 1)* • *To count in multiples of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 25, 50, 100 and 1,000 (Year 4)* • *To find 1, 10, 100 and 1,000 more and one less than a given number (Year 4)* • To count forwards or backwards in steps of powers of 10 for any given number up to 1,000,000 **Representing Number** Children need to know how… • *To recognise the place value of each digit in a 6d number. Represent numbers to 1,000,000 in different ways (concrete, pictorial, abstract), including in numerals and words (Year 5))* • *To partition numbers flexibly (Year 5)* • *To estimate larger numbers and amounts using knowledge of place value, counting and rounding (Year 5)* • *To estimate numbers, using their knowledge of place value, calculations and the number system. (Year 3)* • To read and write numbers to 10,000,000 in numerals and words and represent these in different ways. • To determine the value of each digit in 8 digit numbers.	Children need to know when… • *When to use place value knowledge to solve word problems involving quantities, such as identifying the place value of different items or amounts. Example: solving a word problem that asks how many tens are in a group of 230 marbles. (Year 3)* • *When to use subtractive notation for Roman numerals, based on the placement of symbols.* • *When to round up and when to round down.* • *When rounding may be an effective strategy to support our calculation.* Children need to know why… • ***We use place value charts and squared paper for representing number in maths.*** *Our maths system has a base 10 structure. Each column represents a different place value. Using columns to lay out our digits allows us to represent numbers efficiently. (Year 2)* • ***The < = and > are written the way they are.*** *The wide side of the symbol represents a greater quantity (you could physically fit more counters on that side of the sign). An equals sign consists of two parallel lines because you can fit the same quantity either side. (Year 2)*

- *Numbers can be partitioned into their place value (e.g. hundreds, tens and ones) but also in a range of other ways. (Year 3)*
- *Estimate means to make a 'sensible guess' using your knowledge of number. (Year 2) One common way to estimate involves using rounding.*
- *There are 10 ones in one ten. (Year 1)*
- *There are 10 tens in a hundred; there are 100 ones in one hundred. (Year 2)*
- *There are 10 hundreds in one thousand; there are 100 tens in one thousand; there are 1000 ones in one thousand (Year 3).*
- *A comma is used to separate the digits in the thousands and hundreds columns, which helps us read it out loud. (Year 4)*
- *A ten-thousand is written 10,000. There are 10 thousands in a ten-thousand. There are 100 hundreds in a ten-thousand. There are 1000 tens in a ten-thousand. There are 10,000 ones in a ten-thousand. (Year 5)*
- *A hundred thousand is written 100,000. There are 10 ten-thousands in a hundred-thousand. There are 100 thousands in a hundred thousand. There are 1000 hundreds in a hundred thousand. There are 10,000 tens in a hundred thousand. There are 100,000 ones in a hundred thousand. (Year 5)*
- *A million is written 1,000,000. (Year 5)*
- *A comma is used to separate the millions and hundred thousands digits in a millions number. This helps us read the number out loud. (Year 5)*
- Ten million is written 10,000,000. There are 10 millions in a ten-million. There are 100 hundred thousands in a ten million. There are 1000 ten-thousands in a ten-million. There are 10,000 thousands in a ten-million. There are 100,000 hundreds in a ten-million. There are 1,000,000 tens in a ten million. There are 10,000,000 ones in a ten-million.
- Each place value column represents the next power of 10.

Comparison

Children need to know that…

- *Numbers increase as they go up in the number system and decrease as we count back. (Year 1)*
- *To compare has two different meanings:*
  - *to say how something is like or unlike something else.*
  - *To describe which is larger and which is smaller (and by how many) (Year 2)*
- *Order means to arrange numbers by their numerical value. (Year 2)*
- *We can arrange numbers in ascending order (from smallest to largest) (Year 2)*
- *We can arrange numbers in descending order (from largest to smallest) (Year 2)*
- *< is a mathematical symbol which means less than (Year 2)*
- *> is a mathematical symbol which means more than. (Year 2)*
- *= is a mathematical symbol which means equal to (Year R)*
- *Equal means the same (Year R)*
- *When comparing and ordering numbers, we have to look at the largest place value column first. (Year 3)*
- *It is important to organise our numbers so it is easy to compare place value columns, for example using the squares in our books. (Year 3)*
- *When we find powers of 10 (10,100,1000) more/less, the focus column increases or decreases by 1. (Year 4)*
- *When we are finding a power of 10 more, if this causes 'overflow' we will need to 'regroup' and the next largest column will increase and the focus column will become zero. (Year 4)*
- *When we are finding a power of 10 less, if there is not a sufficient amount in the column in the minuend, we will need to 'exchange'. This means the next largest column will decrease by 1 and the focus column will become 9. (Year 4)*

Rounding

Children need to know that…

- *Rounding numbers makes them 'easier' to use or understand whilst keeping the number close to its original value. (Year 4)*
- *Rounding is a mathematical way of estimating number. (Year 4)*
- *We can round to any place value column. (Year 4)*
- *When rounding, you need to find the place value you are rounding to. This is called your target digit. (Year 4)*
- *You then need to look at the next smallest column. If this is 5 or more, you round up. If this is 0-4 you round down. (Year 4)*
- *When you round up, the target digit increases by one; the digits in larger place value columns stay the same; the digits in smaller place value columns become 0. (Year 4)*
- *When you round down, the target digit stays the same; the digits in larger place value columns stay the same; the digits in smaller place value columns become 0. (Year 4)*
- When you round to a smaller place value column, your rounded number will give you an estimate which is harder to calculate but has higher accuracy.
- When you round to a larger place value column, your rounded number will give you an estimate which is easier to calculate but has lower accuracy.

Negative Numbers

Children need to know that…

- *A negative number is a number less than 0. (Year 4)*
- *Numbers below 0 are shown as minus numbers with the minus symbol (-) e.g. – 8 (Year 4)*

Comparison

Children need to know how…

- *To use the mathematical symbols <, > and (Year 1).*
- *To compare numbers up to 1,000,000 using <,> and = (Year 5).*
- *To order numbers up to 1,000,000 in ascending and descending order (Year 5).*
- *To find 10, 100 and 1000 more or less than a given number (Year 5)*
- To compare numbers up to 10,000,000 using <, > and =.
- To order numbers up to 10,000,000 in ascending and descending order.

Rounding

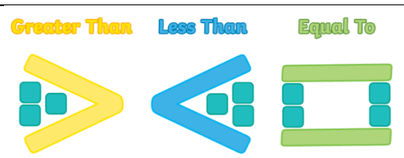
Children need to know how…

- *To round any number to the nearest 10, 100 or 1,000. (Year 4)*
- *To round decimal numbers to the nearest one whole. (Year 4)*
- *To round any number up to 1,000,000 to the nearest 10, 100, 1000, 10,000 and 100,000. (Year 5)*
- To round any integer to a required degree of accuracy.

Negative Numbers

Children need to know how…

- *To count backwards through 0 to include negative numbers (Year 4)*
- *To count forwards and backwards with positive and negative whole numbers, including through zero. (Year 5)*
- *To read, write and interpret negative numbers in context. (Year 5)*



- ***We start from the left-most column when we are comparing numbers.*** *The place value column a digit is in determines its quantitative value. The left-most column is the largest column. Example: A 1 in the thousands column has a greater value than a 9 in the hundreds column. (Year 3)*
- ***We round up when the next smallest column is greater than or equal to 5.*** *'5' is considered to be halfway between the two values. Rounding this up is a universal convention. (Year 4)*
- ***Roman numerals are still learned today.*** *We see them in the world around us (for example on statues, for dates and on clocks) so it is important for us to be familiar with them. (Year 4)*
- ***We introduce a new comma between the millions and hundreds thousands column.*** *Our numbers are written and said in 'chunks' of larger units. The first comma indicates that the three digits on the right are a said 'chunk' of ones. The second comma shows that the hundred-thousand, ten-thousand and thousand columns are read as a 'chunk' of thousands. On the left of that comma, we read a 'chunk' of millions. (Year 5)*
- **We would choose to round to a specific place value column.** This depends on whether ease of calculation or accuracy is most important. If we value accuracy over ease, we would round to a smaller place value column. If we value ease over accuracy, we would round to a larger place value column.

- Calculating intervals across zero refers to determining the difference between a positive and negative number.
- Zero is the midpoint between positive and negative numbers of the same numerals on a number line.

Roman Numerals

Children need to know that…

- *Roman numerals is an ancient number system. Over time, this changed and England adopted the Arabic numeral system, which includes the Base 10 concept and the idea of 0. (Year 4)*
- *Roman numerals are still seen in many places in the world for specific purposes. (Year 4)*
- *In Roman numerals, alphabetic symbols are used as the digits which represent fixed positive numbers(Year 4 & 5)*
    - *In Roman numerals, I means 1*
    - *In Roman numerals, V means 5*
    - *In Roman numerals, X means 10*
    - *In Roman numerals, L means 50*
    - *In Roman numerals, C means 100*
    - *In Roman numerals, M means 1000*
- *To write numbers between these fixed amounts, symbols are listed in succession. (Year 4)*
- *Symbols should be arranged from highest to lowest value, except in subtractive combinations. (Year 4)*
- *A symbol can only be repeated up to three times in succession (e.g., III = 3). (Year 4)*
- *When large symbols are followed by small symbols, the value is calculated by adding. (e.g. XI is 11 because it shows 10 + 1) (Year 4)*
- *If four symbols would be required to make the number, a subtractive combination is used instead. This is where the symbol with the smaller value (subtrahend) is placed before the symbol with the larger value (minuend) to show it needs to be subtracted (e.g. IX is 9 because it shows 10 – 1). (Year 4)*
- *Only certain pairings are allowed for subtractive combinations. Between 1 and 100, these are (e.g., IV = 4, IX = 9, XL = 40, XC = 90). (Year 4)*

Roman Numerals

Children need to know how…

- *To read Roman numerals to 100 (i → c) (Year 4)*
- *To write numbers in Roman Numerals up to 100. (Year 4)*
- *To read Roman numerals to 100 (I to C) (Year 4)*
- *To read Roman numerals to 1000 (m) (Year 5)*
- *To recognise years written in Roman numerals. (Year 5)*

To solve number and practical problems that involve all of the above and with increasingly large positive and negative numbers

Vocabulary

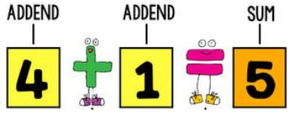
NUMBER	An abstract way of representing a quantity (e.g. 2, 26, fifty-nine, $\frac{1}{2}$, 0.322)	**NUMERAL**	Words or symbols used to represent numbers, made up of digits.	**DIGIT**	The ten single symbols 0-9, used to represent numbers when placed in sequence.
VALUE	How much something is worth. In representation of number, the position of a digit in a numeral determines its value.	**PLACE VALUE CHART**	A picture/diagram used to help represent the value of digits in numbers.	**ESTIMATE**	To make a 'sensible guess' based on your knowledge of and experience with number.
ONE DIGIT NUMBER	A numeral which only contains one digit.	**TWO DIGIT NUMBER**	A numeral which contains two digits. The first digit has a value of tens.	**THREE DIGIT NUMBER**	A numeral which contains three digits. The first numeral has a value of hundreds.
FOUR DIGIT NUMBER	A numeral which contains four digits. The first numeral has a value of thousands.	**ONES**	Where the digit represents the quantity exactly.	**TENS**	A digit value where the digit represents ten-times the quantity. There are 10 ones in a ten.
HUNDREDS	A digit value where the digit represents one-hundred-times the quantity. There are 10 tens in a hundred; there are 100 ones in a hundred.	**THOUSANDS**	A digit value where the digit represents one-thousand-times the quantity. There are 10 hundreds in a thousand. There are 100 tens in a hundred; there are 1000 ones in a hundred.	**PLACE HOLDER ZERO**	Where a zero is placed in a place value column to show there are 0 of that value within the number. This is important to ensure that digits are seen in the correct place value column.
COMPARE	Two meanings: a) to say what is the same or what is different. b) to identify the mathematical difference between numbers.	**EQUAL**	The same as.	**MANIPULATIVE**	A physical object used to help represent mathematics (e.g. beadstring, Base 10).
GREATER THAN >	When the first number is more than the second number. Can be shown by the greater than symbol >	**LESS THAN <**	When the first number is less than the second number. Can be shown by the less than symbol.	**ORDER**	To arrange numbers by their numerical value.
ASCENDING ORDER	Arranging numbers from smallest to largest.	**DESCENDING ORDER**	Arranging numbers from largest to smallest.	**PARTITION**	To split a whole into parts.
PART	A section of the whole.	**WHOLE**	A total amount. This is always the sum of the parts.	**REPRESENTATION**	A way of showing a mathematical ideas using objects, pictures or numerals.
CONCRETE	A representation of a mathematical idea using manipulatives or real life objects.	**PICTORIAL**	A representation of a mathematical idea using pictures.	**ABSTRACT**	A representation of a mathematical idea using symbols (e.g. numerals)
NUMBER LINE	A picture used to represent numbers and calculations where numbers are shown on a regular scale.	**PART-PART WHOLE MODEL**	A pictorial representation of number showing the relationship between parts and wholes.	**BAR MODEL**	A form of part-part whole model where the parts are represented by adjacent bars.
EXPANDED FORM	a way of writing numbers to show the value of each digit (e.g., 325 written as 300 + 20 + 5)	**ROUNDING**	To alter a number to be less exact by taking it to the nearest 'one' of a specified place value column. This makes it more convenient for calculating with.	**NEGATIVE NUMBER**	A number less than 0. This is shown by the minus symbol.
MINUS SYMBOL/SIGN	A mathematical symbol used to indicate either subtraction (when it is placed between the minuend and the subtrahend) or a negative number (when it is placed directly before a number)	**ROMAN NUMERAL**	A number system used by the Roman Empire which used letters to represent numbers.	**I**	One in Roman Numerals.
V	Five in Roman Numerals.	**X**	Ten in Roman Numerals.	**L**	Fifty in Roman Numerals.
C	One hundred in Roman Numerals.	**M**	A thousand in Roman Numerals		
ADDITIVE COMBINATION	When a combination of values are added together to create a sum.	**SUBTRACTIVE COMBINATION**	Where a combination of values is interpreted by subtracting the value of one from the value of the other.		

Addition and Subtraction

Addition

Children need to know that…

- *Addition (adding) is when you put two or more numbers together to find a total amount (part + part = whole) (Year R)*
- *+ means add (Year 1)*
- *Addition is commutative. Commutative means you can do it in any order. (Year 1)*
- *Number bonds refer to pairs of numbers that add together to total a given amount. (Year 1)*

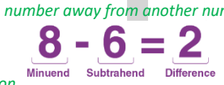


- *The vocabulary of addition: (Year 1)*
- *When we know both parts (addends) but not the whole (sum) we are being asked to do addition. (Year 2)*
- *Inverse is the opposite calculation. Addition is the inverse to subtraction. (Year 2)*
- *Estimate means to make a 'sensible guess' using your knowledge of number. (Year 2,3,4)* We can estimate by rounding numbers to make them easier to add. This allows us to check whether the answer to our calculation is reasonable. (Year 4)
- *To recognise the place value of each digit in numbers up to 1,000,000. (Year 5 Autumn 1)*
- *We lay our digits out in columns, one digit per square to make the place value of these numbers obvious. (Year 3)*
- *In columnar addition, digits with the same place value must always be placed in the same column. (Year 3)*
- *In columnar addition, we begin our calculation with the smallest place value column. (Year 3)*
- *Regrouping means rearranging numbers into groups by place value to make it easier to carry out operations. (Year 3)*
- *We can regroup 10 ones to create 1 ten. (Year 3) We can regroup 10 tens to create 1 hundred. (Year 3)* We can regroup 10 hundreds to create 1 thousand. (Year 4) *We can regroup 10 thousands to create 1 ten-thousand. We can regroup 10 ten-thousands to create 1 hundred thousand. We can regroup 10 hundred-thousands to create 1 million. (Year 5)*
- We can regroup ten millions to create 1 ten-million.

Subtraction

Children need to know that…

- *Subtraction is when you take one number away from another number and is represented by the symbol '-' (Year R)*



- *The formal language of subtraction (Year 1)*
- *When we know one part (subtrahend) and the whole (minuend) but not the other part (difference), we are being asked to do subtraction. (Year 2)*
- *Subtraction is not commutative (Year 2)*
- *In mathematics, difference means the 'gap' between two numbers. This is also the answer to a subtraction question. (Year 2)*
- *Inverse is the opposite. Addition is the inverse to subtraction. (Year 2)*
- *If the minuend is smaller than the subtrahend, the difference will be a negative number. (Year 4)*
- *We can estimate by rounding numbers to make them easier to subtract. This allows us to check whether the answer to our calculation is reasonable. (Year 4)*
- *We lay our digits out in columns, one digit per square, to make the place value of these numbers obvious. (Year 2)*
- *In the formal written method of columnar subtraction, digits with the same place value must always be placed in the same column. (Year 3)*
- *In the formal written method of columnar subtraction, we begin our calculation with the smallest place value column. (Year 3)*
- *Exchanging is when you substitute 1 unit from a larger place value for 10 units from the next smallest place value. (Year 3)*
- *We can exchange 1 ten for 10 ones (Year 3) We can exchange 1 hundred for 10 tens (Year 3) We can exchange 1 thousand for ten hundreds (Year 4) We can exchange 1 ten-thousand for 10 thousands. We can exchange 1 hundred-thousand for 10 ten-thousands. We can exchange 1 million for 10 hundred-thousands. (Year 5)*
- We can exchange 1 ten-million for 10 millions.

Children need to know how…

- *To identify whether a problem requires addition or subtraction using knowledge of parts and wholes (addends and sum; minuend, subtrahend and difference). (KS1)*
- *To use appropriate mental strategies when adding and subtracting increasingly large numbers (see number facts and mental strategies mapping)*
- *To identify fact families and inverse calculations (Year 3)*
- *To solve missing number problems using the inverse relationship (KS1)*
- *To check their calculations using the inverse relationship (Year 3/4)*
- *To check the reasonableness of an addition/subtraction calculation by estimating using rounding (Year 4)*
- *To confidently select a checking strategy (e.g. inverse, rounding) (Year 5)*
- *To use rounding to determine levels of accuracy when reasoning and problem solving. (Year 5)*
- *To accurately lay calculations out using the squares in their books to support a formal written method for addition/subtraction*
- *To add and subtract numbers with more than four digits using the formal written method of columnar addition/subtraction (Year 5)*
- *When adding, to regroup in the tens, hundreds, thousands, ten-thousands, hundred-thousands and millions columns (Year 5)*
- *When subtracting, to exchange from the tens, hundreds, thousands, ten-thousands, hundred thousands and millions columns (Year 5)*
- *To solve addition and subtraction multi-step problems in context, deciding which operations and methods to use and why. (Year 5)*
- To perform mental calculations, including with mixed operations, efficiently with increasingly large numbers.
- To add and subtract numbers (including decimals) using the formal written method of columnar subtraction within their knowledge of place value.
- To determine, in the context of a problem, an appropriate degree of accuracy to use when rounding to estimate and check reasonableness.

Children need to know …

- *A specific calculation strategy may be most useful (e.g. number line, mental strategies, use of manipulatives, pictorial representations, formal written subtraction) (*
- *When regrouping is required in formal columnar addition. (Year 5)*
- *When exchanging is required in formal columnar subtraction (Year 5)*
- *Where to start adding/subtracting from when using the formal written method of columnar addition/subtraction: the smallest place value column (Year 3)*
- *When to use addition/subtraction to solve missing number problems or problems in context based on reasoning about parts and wholes. (Year 4)*
- *When it is appropriate to check calculations by adding the numbers in reverse order, using the inverse, use rounding to estimate etc. (Year 3/4)*
- *When we need to use reasoning language to explain our confidence in our calculations or to justify the approach we have taken. (Year 3)*
- *When a problem involves more than one step. (Year 4)*
- When accuracy is most important while estimating; when speed is most important when estimating.

Children need to know why

- ***We need to know whether we are looking at a part or a whole.*** *Knowing whether we are looking at a part or a whole helps us to know whether we need addition or subtraction.*
- ***We learn to manipulate numbers mentally first.*** *It is often most efficient to use a mental method. The best mathematicians use the most efficient method to solve a problem.*
- ***Regrouping is necessary.*** *We can never have more than 9 in a single place value column as, for example, 10 ones are equivalent to 1 ten. (Year 3)*
- ***The process of regrouping is the same even when the place value gets larger.*** *We have a B10 number system, which means every column is 10 times bigger than the one on its right. (Year 4)*
- ***We begin column addition and subtraction with the smallest column.*** *It is possible that we will have to regroup if the sum of a single place value column exceeds 9 of that value. When we have to regroup, this changes the sum of the next biggest column. (Year 4)*
- ***We cannot simply switch the digits in the minuend and subtrahend around.*** *Subtraction is not commutative as the minuend is the whole, not a part. (Year 3)*
- ***We can exchange from the next largest column.*** *10 ones are equivalent to 1 ten. 10 tens are equivalent to 1 hundred. Therefore exchanging them does not change the overall value. (Year 3)*
- ***Using estimation to check a calculation is sensible.*** *Anyone can make calculation errors. Estimation is an efficient way of checking whether this has occurred. (Year 3)*

Vocabulary

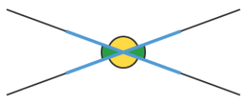
PARTITION	To split a whole into parts.	**EQUAL**	The same as.	**PART**	A section of the whole.
EQUATION	A mathematical representation of the equality of two groups (e.g. 16 + 5 = 21)	**EXPRESSION**	A mathematical representation of a calculation (e.g. 16+5)		
WHOLE	A total amount. This is always the sum of the parts.	**REPRESENTATION**	A way of showing a mathematical ideas using objects, pictures or numerals.	**MANIPULATIVE**	A physical object used to help represent mathematics (e.g. beadstring, Base 10).
CONCRETE	A representation of a mathematical idea using manipulatives or real life objects.	**PICTORIAL**	A representation of a mathematical idea using pictures.	**ABSTRACT**	A representation of a mathematical idea using symbols (e.g. numerals)
PART-PART WHOLE MODEL	A pictorial representation of number showing the relationship between parts and wholes.	**BAR MODEL**	A form of part-part whole model where the parts are represented by adjacent bars.	**BEADSTRING**	A manipulative where coloured beads are placed on a string in alternating colours (10 red, 10 white, 10 red…) to support counting in ones and tens.
BASE 10	A manipulative used to show the value of a digit based on the column in which it is placed.	**NUMBER LINE**	A picture used to represent numbers and calculations where numbers are shown on a regular scale.	**NUMBER BOND**	Addition and subtraction number facts which we memorise to support efficient calculation

	PLACE VALUE CHART	A picture/diagram used to help represent the value of digits in numbers.	**ADDITION**	Combining parts.	**COMMUTATIVE**	A calculation which will give the same answer, regardless of the order in which it is performed. Addition and multiplication are commutative.
	NUMBER SENTENCE	A way of representing a mathematical operation using symbols (+,-,x,÷,= etc)	**SYMBOL**	An abstract image used to represent an idea (e.g. digits, +, =)	**FACT FAMILIES**	A set of mathematical facts which are closely related. Knowing on means you know all. For example 2 + 3 = 5, 3 + 2 = 5, 5-3 = 2, 5-2 = 3
	ADDEND	The numbers which are being added. These are parts of the whole.	**SUM**	The answer to an addition. This is the whole.	**EXPANDED FORM**	a way of writing numbers to show the value of each digit (e.g., 325 written as 300 + 20 + 5)
	COLUMNAR ADDITION	The formal written method of column addition	**VERTICAL ADDITION**	Adding by arranging addends in columns, organised by their place value. Formal column method is an example of vertical addition.	**OVERFLOW**	When the sum of the addends in a column is greater than 9. This indicates that you need to regroup before solving.
	REGROUP	In column addition: Regrouping 10 from one column to make one from the next largest place value column.	**REGROUPED DIGIT**	Recording the regroup on the formal written method.	**PARTIAL SUM**	The sum to the addends in each column (not the whole number sentence)
	SUBTRATION	Removing a part from the whole.	**MINUEND**	The whole in a subtraction problem. This is the amount you subtract from and must always come first.	**SUBTRAHEND**	The part which you are taking away from the whole. This always comes after the minuend.
	DIFFERENCE	The answer to a subtraction question. This shows the remaining part (the gap between the part and the whole)	**COUNTING ON**	Starting from a number and counting forwards in the number system. This can be used as a strategy to solve subtraction problems (starting at the subtrahend or difference and counting on to the minuend).	**COUNTING BACK**	Starting from a number and counting backwards. This can be used as a strategy for solving subtraction problems (starting at the minuend and counting back to the subtrahend or difference).
	INVERSE	The opposite calculation. This undoes what was done by the previous calculation. Addition and subtraction are inverse.	**EXCHANGING**	Using your knowledge of the relationship between different place value columns to 'exchange' from a larger column when the digit in the minuend is smaller than the digit in the subtrahend.	**ESTIMATE**	To make a 'sensible guess' based on your knowledge of and experience with number.
	ROUNDING	To alter a number to be less exact by taking it to the nearest 'one' of a specified place value column. This makes it more convenient for calculating with.	**ASSOCIATIVE PROPERTY**	The property that states that the grouping of numbers in addition or subtraction does not affect the result (e.g., (a+b)+c=a+(b+c)(a + b) + c = a + (b + c)(a+b)+c=a+(b+c))	**COMPENSATION**	Adjusting one number to make a calculation easier (e.g., adjusting numbers to end in multiples of ten).
	EFFICIENT	Using the most effective and least time-consuming method to solve addition or subtraction problems	**IDENTITY ELEMENT**	The number zero in addition (e.g., a+0=aa + 0 = aa+0=a).	**INVERSE ELEMENT**	The opposite of a number in addition or subtraction (e.g., a−a=0a - a = 0a−a=0).

Angles

Children need to know that…

- *Angles are a property of shape or a measure of turns. (Year 3)*
- *Angles are measured in degrees. (Year 3)*
- *The symbol for the unit of measure, degrees, is ° (the degree symbol). Unlike the unit of measure for temperature, this is not followed by a letter. (Year 3)*
- *Angles are shown using this type of notation:*
- *Different types of angles: (Year 4&5)*
  - *Acute angle <90º.*
  - *Right angle – 90º (a quarter turn). Right angles are shown by this type of notation.*
  - *Obtuse angle > 90º, <180º*
  - *Straight angle – 180º (half turn).*
  - *Reflex angle >180º, <360º*
- *There are 360° in a whole turn. (Year 3)*
- *A protractor is a tool used to measure the size of angles and draw angles. (Year 5)*
- *When using a protractor to measure, you need to make sure that the vertex of the angle is at the origin on the protractor (the indent or dot at the centre of the bottom line). You then need to read from the scale where the bottom line of the angle is pointing. (Year 5)*
- *When using a protractor to draw, you place the origin of the protractor at the end of a straight line. You then make a mark on the appropriate scale to show where the second, intersecting line should start from.*
- **Vertically opposite angles**
  - Intersecting lines are lines which cross one another at a point (called a vertex).
  - When this happens, the opposite angles are equal.



Children need to know how…

- *To recognise right, straight, acute, obtuse and reflex angles, including in shapes. (Year 5)*
- *To recognise angles at a point. (Year 5)*
- *To use the correct notation to show angles in diagrams (Year 3)*
- *To compare angles up to 360º using <, > and = (Year 5)*
- *To order angles up to 360º (Year 5)*
- *To describe how many degrees there are in an angle, including recognising multiples of right angles (Year 4) and measuring angles carefully with a protractor (Year 5)*
- *To estimate the size of acute, obtuse and reflex angles (Year 5)*
- *To accurately draw angles using a protractor. (Year 5)*
- Recognise angles where they meet at a point, are on a straight line, or are vertically opposite.
- Use knowledge of angles to find missing angles on lines.

Children need to know when…

- *an angle is a property of shape and when it is a measure of turn. (Year 3)*
- *We are looking at an acute, right, straight or reflex angle. (Year 5)*
- *It is necessary to measure and draw angles precisely. or when a rough estimate is acceptable (Year 5)*
- *To add/subtract angles to find the size of missing angles in a diagram. (Year 5)*
- *To check the reasonableness of a measurement using estimation. (Year 5)*
- *To use measurement tools (protractors/rulers) (Year 5)*
- The position of angles relative to one another on lines can help us calculate the size of an angle.

Children need to know why…

- ***We learn to describe movement.** Sometimes we will need to explain where/how something is moving to someone who is not there. Having the language of position and direction allows us to do this. (Year 1)*
- ***There are two scales on a protractor.** Angles can point in different directions. The two scales allow you to measure angles pointing in different directions with ease. (Year 3)*
- *A right angle notation uses a 'box'. Because this reflects the 90º turn of a right angle. This visual similarity helps people to identify this important angle efficiently in diagrams. (Year 3)*

Properties of Shapes

2D Shape

Children need to know that…

- *A 2D shape is a shape that has 2 dimensions (width/height). It is flat and can only ever be drawn, not held. (Year 1)*
- *2D shapes have sides and vertices (Year 1)*
- *A polygon is a word for a multiple sided shape. (Year 3)*
- *A semicircle is exactly half of a circle. (Year 3)*
- *Geometric properties are the specific characteristics of geometric shapes (e.g. lines, vertices, angles, faces etc) (Year 5)*
- *The names and properties of a range of different 2D shapes: circles, triangles, quadrilaterals, pentagons, hexagons, heptagons, octagons, nonagons, decagons, hendecagons and dodecagons (Year 5)*
- *The names and properties of a range of quadrilaterals: squares, rectangles, trapeziums, rhombuses, parallelograms (Year 3)*
- *The names and properties of a range of triangles: equilateral, isosceles, scalene, right angled. (Year 4)*

2D Shape

Children need to know how…

- *To recognise, identify compare and classify 2D shapes, based on their properties, including types of triangle and quadrilateral. (all previous year groups)*
- *To recognise 2D shapes in different orientations and sizes. (Year 1)*
- *To choose an appropriate geometrical property to compare/classify a group of 2D shapes.*
- *To use accurate geometric vocabulary (e.g. side, vertex) (Year 3)*
- *To draw 2D shapes with accuracy (Year 3)*
- *To recognise lines of symmetry in 2D shapes presented in different orientations. (Year 4)*
- *To complete a drawing of a 2D shape which is symmetrical when given one side of the line of symmetry. (Year 3)*

Children need to know when…

- *We use a ruler to draw shapes. (Year 3)*
- *we draw a symmetrical shape, it can be divided into two parts which are mirror images of one another. (Year 3)*
- *comparing shapes we can choose to compare them based on their properties such as the number of sides, angles, or symmetry. (Year 3)*
- *we make 3D shapes, all sides must connect to each other with no gaps. (Year 3)*
- *a shape is symmetrical. (Year 4)*
- *a geometrical property would be a useful way of comparing and classifying shapes. (Year 4)*

- *Symmetry means when something is exactly the same on either side. Lines of symmetry can be diagonal, horizontal or vertical. (Year 2)*
- *A regular polygon is a polygon where all sides and angles are equal. (Year 5)*
- *An irregular polygon is a polygon where there is at least one unequal angle or side. (Year 5)*
- *The sum of the angles in different shapes: (Year 5)*
    - *Triangle: 180°* (60° per angle in a regular shape)
    - *Quadrilateral: 360°* (90° per angle in a regular shape)
    - Pentagon: 540° (108° per angle in a regular shape)
    - Hexagon: 720° (120° per angle in a regular shape)
- Parts of a circle
    - Circumference: the perimeter of a circle.
    - Radius (r): the distance from the centre of the circle to the circumference.
    - Diameter (d): the distance from one side of the circumference to the other side, crossing directly through the centre.
- The relationship between the circumference and the radius is d=2r

3D Shape

Children need to know that…

- *A 3-d shape is a solid figure or an object or shape that has three dimensions— length, width, and height (Year 1)*
- *3D shapes have edges, vertices and faces. (Year 1)*
- *A face is a surface of a 3D shape. (Year 1)*
- *An edge is the straight line where 2 edges meet. (Year 1)*
- *A vertex is the point where at least 3 edges meet (Year 1)*
- *The names and properties of a range of 3D shapes: sphere, pyramid, cone, cylinder, triangular prism, cube, cuboid (Year 1)*
- *Orientation is the angle at which an object or shape is presented from. (Year 3)*
- *A net is a 2D representation of the faces of a 3D shape which has been 'opened up'. (Year 5)*

- *To complete simple symmetrical figures with respect to a specific line of symmetry (including horizontal, diagonal and vertical lines of symmetry) (Year 4)*
- *To distinguish between regular and irregular shapes using reasoning about equal sides and angles. (Year 5)*
- *To use the properties of rectangles (internal angles, types of lines) to deduce related facts, missing lengths and missing angles in quadrilaterals and rectilinear shapes. (Year 5)*
- To draw 2D shapes precisely using given dimensions and angles.
- To label the parts of a circle, including radius, diameter and circumference.
- To calculate to diameter when given the radius.
- To calculate the radius when given the diameter.
- To find unknown angles in any triangles or quadrilaterals.
- To describe the interior angles of regular polygons (when given one angle).

3D Shape

Children need to know how…

- *To recognise, identify compare and classify 3D shapes, based on their properties. (all previous year groups)*
- *To choose an appropriate geometric property to compare/classify a group of 3D shapes.*
- *To identify the 2D shapes on the surface of 3D shapes (faces) (Year 2)*
- *To use accurate geometric language (e.g. face, edge, curved surface, flat surface and vertex/vertices). (Year 3)*
- *Recognise 3D shapes in different orientations. (Year 3)*
- *Construct 3D shapes using a variety of equipment (Year 3)*
- *To identify 3D shapes (including cubes and cuboids) from a range of 2D representations, including nets. (Year 5)*
- To confidently identify the net which could have created a given 3D shape.
- To create 3D shapes using a range of different materials.

- *A specific property of a shape will help you find an unknown. (Year 5)*

Children need to know why…

- ***We identify shapes.*** *We identify shapes because we can use 3D shapes to build. Different shapes have different properties so are useful for different things. (Year 1)*
- ***There is no gap between the sides in 3D shapes.*** *3D shapes describe complete, enclosed shapes. (Year 3)*
- ***A specific property may not always be a useful way of comparing and classifying shapes.*** *If the property is shared across all shapes, you will not create meaningful groups. Similarly, if a property is different for all shapes, you will not be able to create meaningful groups. (Year 4)*
- ***Regular and irregular is the term chosen to describe shape:*** *Regular indicates same-ness, whereas irregular indicates difference. (Year 5)*
- ***We need to be able to understand and manipulate nets.*** *Many instances of hollow 3D shapes in real life are constructed from nets. (Year 5)*

Vocabulary

2D SHAPE	A shape with 2 dimensions (flat). They have width and height. They can only be drawn, not held.	**POLYGON**	a closed two-dimensional shape with straight sides.	**SIDES**	The lines which define the outside of a shape.
VERTEX (2D)	The points at which two sides of a shape meet.	**HORIZONTAL**	A straight line which goes from left to right/right to left.	**VERTICAL**	A straight line which goes up and down.
DIAGONAL	A straight line which joins non-adjacent corners of a straight-sided shape.	**LINE OF SYMMETRY**	A line that cuts a shape exactly in half, so the two sides are mirror images of one another.	**SYMMETRICAL**	A shape with at least one line of symmetry.
STRAIGHT	A line which does not curve. These are drawn with a ruler.	**CURVED**	A line that is bent. Usually this is smooth and continuous.	**INTERSECT**	Where two lines cross
PARALLEL LINES	lines that are always the same distance apart and never intersect.	**PERPENDICULAR LINES**	lines that intersect at a right angle (90 degrees).	**INTERSECTING LINES**	lines that cross or meet (but not at a right angle)
ANGLE	A measure of turn. This can describe movement or can be a property of shape.	**VERTICALLY OPPOSITE ANGLE**	The opposite angles formed when two straight lines intersect. These are equal.	**DEGREE**	The unit of measure for angles. Uses the unit notation X°
FULL TURN	Turning a full circle: starting and finishing in the same position. A full turn is 360°	**STRAIGHT ANGLE (HALF TURN)**	Half the size of a full turn. The object will face the opposite direction at the end of the turn. A half turn is 180°	**RIGHT ANGLE (QUARTER TURN)**	Quarter the size of a full turn. The object will be facing to the left or right of its starting direction. A right angle is 90°
PROTRACTOR	A measurement tool used for measuring the size of angles.	**ACUTE ANGLE**	An acute angle is <90°	**OBTUSE ANGLE**	An obtuse angle is > 90° and < 180°
REFLEX ANGLE	A reflex angle is >180° and <360°	**REGULAR POLYGON**	A three or more sided shape where all the sides are the same length and all of the angles are the same size	**IRREGULAR POLYGON**	A three or more sided shape where at least one side or angle is different to the rest.
EQUAL	The same as.	**3D SHAPE**	A shape with 3 dimensions (height, width and depth). These can be held as well as drawn.	**VERTEX (3D)**	The point at which three or more edges meet.
EDGE	The line where two faces meet.	**FACE**	The flat surfaces of a 3D shape.	**SURFACE**	The outside layer of something.
ORIENTATION	The angle at which an object or shape is presented from.	**RADIUS**	The distance from the centre of a circle to the circumference.	**DIAMETER**	The distance from one side of the circumference to the other, passing through the centre of the circle.
CIRCUMFERENCE	The perimeter of a circle.	**INTERIOR ANGLE**	An angle formed on the inside of a shape where two sides meet at a vertex.		

Enrichment & wider development

Year 6 - Autumn 2

National Curriculum Milestones

Number: Multiplication
- Perform mental calculations, including with mixed operations and large numbers
- Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- Identify common factors, common multiples and prime numbers

Number: Division
- Perform mental calculations, including with mixed operations and large numbers
- 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
- 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
- Use their knowledge of the order of operations to carry out calculations involving the four operations **(to be taught in Algebra unit)**

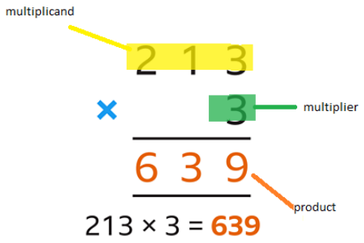
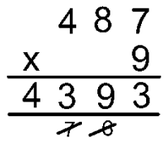
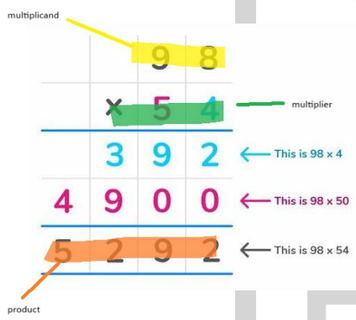
Fractions
- Use common factors to simplify fractions
- Use common multiples to express fractions in the same denomination
- Compare and order fractions, including fractions > 1
- Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions
- Multiply simple pairs of proper fractions, writing the answer in its simplest form [for example, $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$]
- Divide proper fractions by whole numbers [for example, $\frac{1}{3} \div 2 = \frac{1}{6}$]
- Solve problems involving all of the above

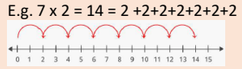
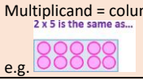
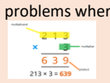
Revisited knowledge

New knowledge

Domains	**Declarative knowledge** (substantive knowledge)	**Procedural knowledge** (disciplinary knowledge)	**Conditional knowledge** (knowing the when and the why)

Multiplication: Multiples, primes and factors	**Multiples, Factors and Primes**
	Children need to know that…
	• *Multiplication is a commutative mathematical operation that indicates how many times a number is added to itself and is represented by the symbol 'x'. (Year 1) It is the inverse of division (Year 3)*
	 
	
	• *The formal language of multiplication. (Year 1)*
	• *Their times tables up to 12 x 12 = 144 and the relationships between these (Year 4)*
	• *A derived fact is a fact worked out using facts you already know (e.g. the relationship between the times tables, known facts and place value, using a known fact and adding a multiple or fact families). (Year 4)*
	• *When any number is multiplied by 0, the product is 0. (Year 4)*
	• *When any number is multiplied by 1, it remains the same. (Year 4)*
	• *When we multiply three numbers together, we multiply the product of the first two numbers by the third number. (Year 4)*
	• *A multiple of a number can be divided by that number without a remainder (e.g. 25 is a multiple of 5 because 25 can be divided by 5 without a remainder). (Year 3)*
	• *A factor is a number that a multiple can be divided by without a remainder (integer quotient). (Year 4)*
	• *Factors pairs are two numbers that, together, act as factors of a multiple. When multiplied together, they create a specific product (Year 5).*
	• *A prime number is a number with exactly two factors: 1 and itself. (Year 5)*
	  ○ *There are 8 prime numbers under 20: 2,3,5,7,11,13,17 and 19.*
	• *A composite number is any non-prime number. It has 3 or more factors. (Year 5)*
	• *A square number is the product of a number multiplied by itself. (Year 5)*
	  ○ *They are called square numbers because, when created with practical resources, they can be arranged in a perfect square array.*
	  ○ *The notation for a square number is N^2*
	  ○ *The first 12 square numbers are 1^2=1, 2^2=4, 3^2=9, 4^2=16, 5^2=25, 6^2=36, 7^2=49, 8^2=64, 9^2=81, 10^2=100, 11^2=121, 12^2=144.*
	• *A cube number is the product of a number which has been multiplied by itself and then by itself again. (Year 5)*
	  ○ *They are called cube numbers because, when created with practical resources, they form a perfect cube.*
	  ○ *The notation for a cube number is N^3*
	  ○ *The first 12 cube numbers are 1^3, 2^3, 3^3, 4^3, 5^3, 6^3, 7^3, 8^3, 9^3, 10^3, 11^3, 12^3*
		Multiples, Factors and Primes
		Children need to know how…
		• *To identify fact families (Year 3)*
		• *To solve problems including missing number problems and inverse operations. (Year 3)*
		• *To use a range of strategies to solve multiplication problems (all previous)*
		• *To multiply by 0 and 1 mentally, explaining mathematically why the product is derived. (Year 3)*
		• *To recall and use multiplication facts for the multiplication tables up to 12 x 12 when solving problems. (Year 3)*
		• *To derive multiplication facts using knowledge of fact families, commutativity and factor pairs and use these to support mental calculation. (Year 5)*
		• *To multiply three numbers together. To select the order to multiply three numbers. (Year 4)*
		• *To solve problems involving multiplying and adding numbers, including integer scaling problems and harder correspondence problems such as n objects are connected to m objects.*
		• *To identify multiples and factors of numbers. (Year 5)*
		• *To find all factor pairs of a number. (Year 5)*
		• *To find common factors of two numbers. (Year 5)*
		• *To establish whether a number up to 100 is prime or composite and explain this using mathematical language. (Year 5)*
		• *To calculate and use square and cube numbers. (Year 5)*
		• To perform mental calculations, including with mixed operations and large numbers.
		• To identify the lowest common multiple (LCM) and highest common factor (HCF) of a group of numbers.
			Children need to know when…
			• *to apply the commutative property of multiplication to reorder factors for easier calculation. (Year 3)*
			• *A problem requires multiplication based on reasoning about wholes, parts and groups (Year 3)*
			• *A question involves finding multiples of a number. (Year 5)*
			• *A number is a factor of a product. (Year 5)*
			• *To use divisibility rules to work out if a number is a factor of another number. (Year 5)*
			• *A number is prime. (Year 5)*
			Children need to know why
			• ***We need to develop rapid recall of key multiplication and division number facts.*** *Having fluent and automatic recall of number facts allows us to 'know' the answer rather than working it out each time. This makes it easier for our brains (reducing cognitive load) which helps us to solve trickier problems. (Year 2)*
			• ***We develop a range of strategies to help simplify and check the products to multiplication calculations.*** *Developing efficiency will allow us to work with numbers quickly and flexibly. (Year 3)*
			• ***The product of any number multiplied by 0 is 0.*** *When we multiply by 0, we either have 0 groups of an amount (0) or we have lots of groups with 0 in (0). In either case, the quantity we have is 0. (Year 4 Autumn 1)*
			• ***The product of any number multiplied by 1 is the same as the original number.*** *When we multiply by 1, we either have 1 groups with an exact amount (itself) or we have an exact number of groups with 1 in (itself). In either case, the quantity we have is the same as the factor we know. (Year 4 Autumn 1)*

Multiplication	**Written multiplication** Children need to know that… • *Multiplication is a commutative mathematical operation that indicates how many times a number is added to itself and is represented by the symbol 'x'. (Year 1) It is the inverse of division (Year 3)*  • *The formal language of multiplication. (Year 1)* • *Their times tables up to 12 x 12 = 144 and the relationships between these (Year 4)* • *A derived fact is a fact worked out using facts you already know (e.g. the relationship between the times tables, known facts and place value, using a known fact and adding a multiple or fact families). (Year 4)* • *When any number is multiplied by 0, the product is 0. (Year 4)* • *When any number is multiplied by 1, it remains the same. (Year 4)* • *The distributive law states that larger numbers can be multiplied by partitioning a large number into smaller parts, multiplying the smaller parts by the multiplier and then adding the products together. (Year 3)* • *Because multiplication is commutative, we can multiply three numbers together in any order. (Year 3)* ***SHORT MULTIPLICATION*** ○ *The formal written method of compact short multiplication uses the distributive law to simplify the multiplication of larger numbers. (Year 4)*  ○ *The multiplier is multiplied by each column of the multiplicand in turn from smallest to largest. (Year 4)* ○ *If the product of a single multiplication is greater than 9, any overflow must be regrouped in the next column, just as is done in column addition. This is recorded with a small notation of the regrouped digit under the next column.* (Year 4)  **LONG MULTIPLICATION** ○ *The formal written method of long multiplication uses the distributive property of multiplication to simplify large calculations. (Year 5)* ○ *The multiplier and multiplicand are arranged neatly in place value columns.*  ○ *The ones digit of the multiplier is multiplied by the multiplicand (following the same process as short multiplication).* ○ *The tens digit of the multiplier is multiplied by the multiplicand (following the same process as short multiplication).* ○ *Before completing the tens-digit multiplication, a place holder zero needs to be placed in the ones column. This is because the multiplier has a value of tens.* ○ *The two partial-products then need to be added together to find the final product.*	**Multiplication** Children need to know how… • *To identify whether a problem requires multiplication or division using more advanced mathematical language and reasoning (e.g. part, whole, multiplier, multiplicand, product, dividend, divisor, quotient) (Year 2)* • *To solve missing number questions using the inverse. (Year2)* • *To choose the most efficient method (Year 2)* • *To write and calculate mathematical statements for 2s x 1d multiplication statements using the related facts of tables they know (Year 3)* • *To multiply by 0 and 1 mentally, explaining mathematically why the product is derived. (Year 3)* • *To recall and use multiplication facts for the multiplication tables up to 12 x 12 when solving problems. (Year 3)* • *To multiply integers and decimals by 10, 100 and 1000. (Year 5)* • *To multiply numbers with up to four digits by a one-digit number using the formal written method of compact short multiplication. (Year 5)* • *To multiply numbers with up to 4 digits by a 2-digit number using the formal written method of long multiplication. (Year 5)* • *To solve problems involving multiplying and adding numbers (including integer scaling problems; harder correspondence problems such as n objects are connected to m objects; a combination of operations; scaling by simple fractions and problems involving simple rates). (Year 5)*	Children need to know when… • *to use a times table based on the factors in the problem. (Year 3)* • *it is appropriate to use known multiplication facts to find related products. (Year 4)* • *to apply the commutative property of multiplication to reorder factors for easier calculation. (Year 3)* • *to use times tables knowledge to check the accuracy of multiplication answers. (Year 3)* • *A problem requires multiplication based on reasoning about wholes, parts and groups (Year 3)* • *When accurate use of place value columns is important to ensure accurate calculation. (Year 3)* • *To use estimation (rounding) to check the reasonableness of an answer (Year 4)* • *to use short compact formal written multiplication to solve a multiplication problem. (Year 4)* • *To use long multiplication to solve a problem. (Year 5)* Children need to know why • ***We need to develop rapid recall of key multiplication and division number facts.*** *Having fluent and automatic recall of number facts allows us to 'know' the answer rather than working it out each time. This makes it easier for our brains (reducing cognitive load) which helps us to solve trickier problems. (Year 2)* • ***We develop a range of strategies to help simplify and check the products to multiplication calculations.*** *Developing efficiency will allow us to work with numbers quickly and flexibly. (Year 3)* • ***You need to multiply each digit from the multiplier by the multiplicand before adding to find the product.*** *The expanded column method works by partitioning the multiplier into tens and ones and completing two smaller multiplications which can be assisted by knowing our number facts. (Year 3)* • ***Regrouping is also important in formal written multiplication.*** *Often, the products of your multiplications will be greater than 9. Therefore, because 10 ones are equivalent to one 10, it is important to exchange to know how many are* in each column. (Year 3) • ***The product of any number multiplied by 0 is 0.*** *When we multiply by 0, we either have 0 groups of an amount (0) or we have lots of groups with 0 in (0). In either case, the quantity we have is 0. (Year 4 Autumn 1)* • ***The product of any number multiplied by 1 is the same as the original number.*** *When we multiply by 1, we either have 1 groups with an exact amount (itself) or we have an exact number of groups with 1 in (itself). In either case, the quantity we have is the same as the factor we know. (Year 4 Autumn 1)* • ***We progress from expanded column multiplication to compact short multiplication.*** *It is a more efficient method and supports our progress to long multiplication of a 3d x 2d number in upper KS2. (Year 5)* • ***We use long multiplication to multiply larger numbers by a 2 digit numbers.*** *It allows us to use our knowledge of place value to simplify larger calculations and solve large multiplications with accuracy. (Year 5)* • ***We put a placeholder zero in the ones column when we multiply by the tens number of the multiplier.*** *The tens number of the multiplier has a value of 'ten'. Therefore, placing the zero in the ones column retains that place value. (Year 5)*

	• *Scaling is when you are given information about something and then have to apply it to a smaller or larger quantity (e.g. 3 times as many). (Year 5)* • *Rates are a fixed price paid or charge for something. (Year 5)*					
Vocabulary	**EQUAL**	The same as.	**EQUAL GROUPS**	The same quantity in each group.	**MULTIPLICATION**	When you have lots of copies of the same group or number.
	MULTIPLIER	The number you are multiplying by.	**MULTIPLICAND**	The number which is being multiplied	**PRODUCT**	A result of multiplying two or more numbers together.
	COMMUTATIVE	A calculation which will give the same answer, regardless of the order in which it is performed. Addition and multiplication are commutative.	**REPEATED ADDITION**	A way of solving multiplication problems where the multiplicand is added repeatedly using a number line or number sentences. E.g. 7 x 2 = 14 = 2 +2+2+2+2+2+2 	**ARRAY**	A way of showing (and solving) multiplication problems where groups are arranged systematically in rows and columns. Multiplier = rows. Multiplicand = columns. e.g. 
	INVERSE	The opposite calculation. This undoes what was done by the previous calculation. Multiplication and division are inverse operations.	**TIMES TABLES**	a list of multiplication facts for a particular number which need to be memorised and quickly recalled.	**DERIVED FACT**	A fact worked out using facts you already know.
	EVEN NUMBER	Multiples of 2. These can be divided by 2 without leaving a remainder. Even numbers end in 0,2,4,6,8.	**ODD NUMBER**	Numbers which are not multiples of 2. These leave a remainder when divided by 2. Odd numbers end in 1,3,5,7,9	**FACT FAMILIES**	A set of mathematical facts which are closely related. Knowing on means you know all. For example 2 x 3 = 6, 3 x 2 = 6, 6 ÷ 3 = 2, 6 ÷2 = 3
	MULTIPLE	The products which are created from a specific multiplier. E.g. multiples of 2 are 2,4,6,8,10…	**FACTOR**	A number which a multiple can be divided by without a remainder (giving an integer quotient)	**PRIME NUMBER**	A number which only has 2 factors: one and itself.
	LOWEST COMMON MULTIPLE	The lowest possible number which is a multiple of two or more different numbers.	**HIGHEST COMMON FACTOR**	The highest possible number which is a factor of two or more different numbers.		
	SQUARE NUMBER	The product of a number multiplied by itself	**CUBE NUMBER**	The product of a number multiplied by itself and then by itself again.	**DISTRIBUTIVE LAW**	The mathematical law that states larger numbers can be multiplied by partitioning the large number into smaller parts, multiplying the smaller parts by the multiplier and then adding the products together. (e.g. 29 x 4 can be solved by doing (20 x 4) + (9 x 4)
	COMPACT SHORT MULTIPLICATION	The formal written method used to solve larger multiplication problems where the multiplier has 1 digit. 	**LONG MULTIPLICATION**	A formal written method used to multiply a larger multiplicand by a 2 digit multiplier. 	**INTEGER**	A whole number.

Division

Children need to know that…

- *Equal means the same and is shown by the symbol = (Year 1)*
- *'Equal groups' means you have the same number of objects in each group. (Year 1)*
- *Division can be seen in two ways: (Year 1)*
  - ***Division as sharing:*** *sharing the dividend into a specific number of groups (e.g. 12 ÷ 2 → share 12 equally between two groups. How many counters are in each group?).*
  - ***Division as grouping:*** *is sharing the dividend into equal size groups. (e.g. 12 ÷ 2 → group the 12 counters into lots of groups of two. How many groups are there?)*
- *÷ is a symbol that means division. (Year 1)*
- *The formal language of division (dividend, divisor, quotient) (Year 1)*
- *Half means dividing something by 2 (Year 1)*
- *Division is not commutative. (Year 2)*
- *In division, the whole (dividend) must always be before the divisor (Year 2)*
- *Multiplication is the inverse of division (Year 2)*
- *A multiple of a number can be divided by that number without a remainder (e.g. 25 is a multiple of 5 because 25 can be divided by 5 without a remainder). (Year 3)*
- *Relationships between the times tables they know (all) (Year 4 Autumn 1).*
- *A remainder is the amount left over when something cannot be shared or grouped equally. (Year 3)*
- *Dividend is the whole. The number which is to be divided. (Year 3)*
- *Divisor is the number the dividend is going to be divided by. This could tell us the number of groups to create (dividing by sharing) or the number in each group (dividing by grouping). (Year 3)*
- *Quotient is the answer to a division question. This could mean the number of groups created or the quantity in each group, depending on whether we are dividing by grouping or by sharing. (Year 3)*
- *Divisibility Rules for 1, 2, 3, 4, 5, 8 and 10. (Year 3)*
- *A derived fact is a fact worked out using facts you already know (e.g. the relationship between the times tables, known facts and place value, using a known fact and adding a multiple or fact families). (Year 3)*
- *A factor is a number that a multiple can be divided by without a remainder (it gives an integer quotient). (Year 3)*
- *An integer is a whole number. (Year 3)*
- *Factors come in pairs, which multiply together to create a multiple. (Year 3)*
- *Any number divided by 1 remains the same. (Year 4)*
- *The divisibility rules*
- *We can derive division facts using known facts (e.g. fact families, place value) (Year 4)*

Children need to know how…

- *To represent division as sharing and grouping (Year 1)*
- *To identify whether a problem requires multiplication or division using more advanced mathematical language and reasoning (e.g. part, whole, multiplier, multiplicand, product, dividend, divisor, quotient) (Year 2)*
- *To solve division problems using an appropriate method (all previous year groups)*
- *To solve problems involving a mixture of operations.*
- *To solve problems including understanding the meaning of the equals sign.*
- *To solve problems involving scaling by simple fractions and problems involving simple rates.*
- *To use the inverse relationship between multiplication and division. (Year 2)*
- *To solve missing number problems using the inverse relationship. (Year 2)*
- *To divide integers by 10, 100 and 1000. (Year 5)*
- *To check the reasonableness of answers using estimation (rounding/known facts) (Year 4)*
- *To divide any number by 1. (Year 4)*
- *To use divisibility rules to suggest whether a division will be possible without a remainder before calculating. (Year 4)*
- *To recall and use division facts for multiplication tables up to 12 x 12. (Year 4)*
- To choose the most appropriate method, including mental calculations with mixed operations and larger numbers

SHORT DIVISION

- *To divide numbers with up to four digits by a one digit number using the formal written method of short division. (Year 5)*
- *To exchange where necessary when using the formal written method of short division. (Year 5)*
- *To interpret remainders appropriately for the context. (Year 5)*
- To divide numbers with up to four digits by a two-digit number (within tables knowledge) using the formal written method of short division.
- To represent remainders as decimals, fractions and remainders.

LONG DIVISION

- *To interpret remainders appropriately for the context. (Year 5)*

Children need to know…

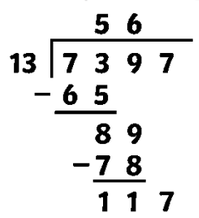
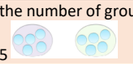
- *When a question requires multiplication or division based on their knowledge of the underlying structures of these calculations. (Year 2)*
- *When a strategy is useful and appropriate for solving a division problem (Year 2)*
- *When a problem can be solved mentally using a known fact (Year 2)*
- *Which multiplication fact they have learned will help them solve a division problem. (Year 3)*
- *When we are looking at missing number problems, we need to work out which part of the problem we are missing. (Year 3)*
- *When to use the inverse to check an answer. (Year 3)*
- *Where patterns can be used to help solve more complex division problems efficiently (e.g. repeatedly dividing by 2). (Year 3)*
- *When a problem can be solved mentally using a derived fact. (Year 4)*
- *When to determine the price per unit when solving a rates problem.(Year 5)*
- When a remainder should be reported as a whole number remainder, fraction or should be rounded.

Children need to know why…

- ***There are a range of ways of solving multiplication and division problems.*** *Different problems may be visualised better using different representations. (Year 1)*
- ***You get the same quotient regardless of whether you solve a division problem by grouping or sharing.*** *We can rotate our array to show the commutative nature of multiplication. (Year 1)*
- ***We need to develop rapid recall of key multiplication and division number facts.*** *Having fluent and automatic recall of*

<table>
<tr>
<td></td>
<td colspan="2"><u>SHORT DIVISION</u>
• The formal written method of short division is sometimes called ‘bus stop’ method. (Year 4)


• (Year 4)
• The formal written method of short division uses knowledge of ‘division by grouping’ and partitioning (see calculation policy for exemplification) (Year 4)
• Calculation starts from the largest place value column. (Year 4)
• If there is a remainder in a column, it is exchanged into the next smallest column. This is recorded on the formal written method using a small, superscript digit. (Year 4)

<u>LONG DIVISION</u>
• The formal written method of long division is an extension of short division, used to help divide significantly larger numbers that might not be easily divisible using simple mental arithmetic.
• This method is normally used when the divisor is a larger 2-digit (or more) number.
• The formal written method of long division uses knowledge of division by grouping and partitioning (see calculation policy for exemplification)
• Calculation starts from the largest place value column.
• If there is a remainder in a column it is exchanged into the next smallest column. This is recorded underneath the formal written method as shown in the picture on the right.
 </td>
<td>• To divide numbers with up to four digits by a two-digit number using the formal written method of long division.</td>
<td>number facts allows us to ‘know’ the answer rather than working it out each time. This makes it easier for our brains (reducing cognitive load) which helps us to solve trickier problems. (Year 2)
• An open array is a useful way of visualising division problems. Open arrays can help us when we are multiplying and dividing much larger numbers. They also help us to solve area problems later on. (Year 2)
• The formal written method starts with the largest column. Because we are dividing by grouping, there may be a remainder left. If there is a remainder, this needs to be exchanged into a smaller column. If we started from a smaller column, when we reached a column which required an exchange, we would then need to recalculate the previous columns. (Year 4)
• Remainders occur. Remainders occur when we cannot divide a dividend perfectly by the divisor.</td>
</tr>
<tr>
<td>Vocabulary</td>
<td colspan="5">
<table>
<tr><td>EQUAL</td><td>The same as.</td><td>EQUAL GROUPS</td><td>The same quantity in each group.</td><td>INVERSE</td><td>The opposite calculation. This undoes what was done by the previous calculation. Multiplication and division are inverse operations.</td></tr>
<tr><td>DIVISION</td><td>Where a whole is split into two or more equal groups.</td><td>DIVISION AS SHARING (PARTITIVE DIVISION)</td><td>The divisor tells you the number of groups to share the dividend between. E.g. 10÷2=5
  </td><td>DIVISION AS GROUPING (QUOTIVE DIVISION)</td><td>The divisor tells you the number in each group. E.g. 10÷2=5
  </td></tr>
<tr><td>DIVIDEND</td><td>A number to be divided by another number (the whole)</td><td>DIVISOR</td><td>The number which the dividend is being divided by. Tells you either the number of parts or the size of each part.</td><td>QUOTIENT</td><td>A result of dividing one number by another. Depending on the role of the divisor, this either tells you the number of parts or the size of each equal part.</td></tr>
<tr><td>FACT FAMILIES</td><td>A set of mathematical facts which are closely related. Knowing on means you know all. For example 2 x 3 = 6, 3 x 2 = 6, 6 ÷ 3 = 2, 6 ÷2 = 3</td><td>REMAINDER</td><td>The amount left over when you divide a dividend by a divisor which cannot divide perfectly.</td><td>REPEATED SUBTRACTION</td><td>A strategy for solving division problems where you count back in multiples, sometimes supported by a number line.</td></tr>
<tr><td>SHORT DIVISION</td><td>A formal written method used to solve some larger division problems. This is sometimes colloquially called bus stop method.</td><td>LONG DIVISION</td><td>A formal written method used to solve some larger division problems.</td><td></td><td></td></tr>
</table>
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<tr>
<td>Fractions</td>
<td>Representing Fractions
Children need to know that…
• A fraction represents part of a whole. A whole is your total amount/shape. A part is an equal section of your total amount/ shape. (Year 1)
• When we write a fraction, the bottom number describes the total number of equal parts that the whole has been split into. This is called the denominator The top number describes the number of parts you have. This is called the numerator. (Year 2)
• The straight line between the numerator and the denominator is called the dividing line. (Year 2)
• A unit fraction is any fraction with 1 as its numerator and an integer for the denominator (e.g. $\frac{1}{2}$) (Year 3)
• A non-unit fraction is a fraction where the numerator is greater than 1 (e.g. $\frac{3}{4}$). (Year 3)
• To find a fraction of a quantity, we need to first divide by the denominator and then multiply by the numerator. (Year 3)
• A fraction smaller than one whole is known as a proper fraction (the numerator is smaller than the denominator) (Year 5)
• Fractions larger than one whole can be written in different ways: (Year 5)
  ○ Improper Fractions: The numerator is larger than the denominator.
  ○ Mixed Numbers: The improper fraction is partitioned into ‘wholes’ and ‘parts’. The wholes are written as an integer number. This is shown by using a larger notation. The part is shown as a proper fraction. For example, $\frac{6}{5}$ (improper fraction) = $1\frac{1}{5}$ (mixed number)
• We usually express fractions greater than 1 as mixed numbers. (Year 5)

Equivalence
Children need to know that…
• Equivalent fractions are fractions that describe the same fraction of an amount/number but which look different(Year 3)
• A group of equivalent fractions is called a ‘fraction family’(Year 4)
• Common denominators means a pair or group of fractions have the same denominator. (Year 5)
• We can create new equivalent fractions in two ways: (Year 5)</td>
<td>Representing Fractions
Pupils need to know how…
• To identify when you have equal parts/groups (Year 1)
• To identify a half, a quarter, a third, two quarters and three quarters of a shape, object or quantity (KS1)
• To write number sentences to describe fractions of quantities (including lengths) – e.g. $\frac{1}{2}$ of 6 = 3. (Year 2)
• To find a tenth of a quantity or shape by diving the whole by 10 (Year 3)
• To count up and down in tenths e.g. 1/10, 2/10, 3/10…(Year 3)
• To recognise, find and write unit fractions of a discrete set of objects by counting the objects to find the denominator (Year 3)
• To recognise, find and write non-unit fractions of a discrete set of objects by counting all the objects to find the denominator and counting the taken part to find the numerator (Year 3)
• To recognise, find and write unit fractions of a quantity (Year 3)
• To recognise, find and write non-unit fractions of a quantity (Year 3)
• To count up and down in hundredths. To find a hundredth of a quantity or shape by dividing the whole by 10. To find a hundredth of a quantity or shape by dividing a tenth by 10. (Year 4)
• To calculate increasingly large unit and non-unit fractions of an amount by dividing by the denominator and multiplying by the numerator where the answer is a whole number. (Year 4)
• To convert between mixed numbers and improper fractions. (Year 5)
• To give the answer to fraction calculation as fractions in their simplest form.
• To represent fractions greater than 1 as mixed numbers.

Equivalence
Pupils need to know how…
• To show that $\frac{2}{4}$ is equivalent to $\frac{1}{2}$. (Year 2)
• To recognise and show pairs of equivalent fractions by writing and drawing diagrams (Year 3)
• To show families of equivalent fractions using diagrams. (Year 4)</td>
<td>Children need to know when …
• A part is equal or unequal. (Year 1)
• Fractions which look different are describing the same thing (equivalent fractions $\frac{2}{4}$ and $\frac{1}{2}$).(Year 2)
• To use visual models (e.g. equivalence) and when to use calculation (e.g. simple fractions of quantities) to solve fractions problems. (Year 3)
• Multiplication and division facts can be used to help solve fractions problems. (Year 3)
• We can just add/subtract the numerators (when the denominators are the same) (Year 3)
• To use fraction knowledge to help us solve real-life problems (e.g. sharing an object equally between friends, making a recipe work for less people). (Year 3)
• To represent a fraction >1 as a mixed number and when to represent it as an improper fraction.
• A common denominator needs to be found to solve a problem.
• To find the common denominator by simplifying.
• To find the common denominator by multiplying.
• To use ‘fractions of amounts’ as a strategy for multiplying a fraction by an integer.
• To use ‘repeated addition’ (multiplying the numerator only) as a strategy for multiplying a fraction by an integer.
• To use the distributive law to multiply a fraction by an integer.

Children need to know why…</td>
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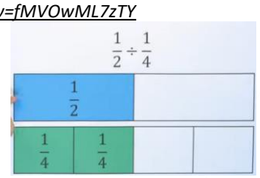
</table>

	○ *Multiplying the numerator and denominator by the same multiplier.* ○ *Dividing the numerator and denominator by the same divisor. This is called simplifying the fraction.* • *A fraction in its **simplest form** is the equivalent fraction with the smallest possible value for the numerator and denominator. (Year 5)* • We can find the simplest form of a fraction by dividing by the highest common factor of the numerator and denominator. **Comparing and Ordering Fractions** Children need to know that… • *< means is greater than (more than) (Year 2)* • *> means is fewer than (less than) (Year 2)* • *= means is equal to (Year 2)* • *We can compare fractions with the same denominator by looking at the numerator. The larger the numerator, the larger the fraction.* • *We can compare fractions with the same numerator by looking at the denominator. The larger the denominator, the smaller the fraction.* • *We can compare fractions with different numerators and denominators using pictorial representations, such as a fraction wall or bar model.* • *We can order fractions in ascending or descending order. (Year 5)* • *We can use our knowledge of equivalent fractions to create pairs of fractions with common denominators. (Year 5)* • *Fractions with different denominators can be compared by finding equivalent fractions with a common denominator. (Year 5)* • Fractions can be compared by converting them into decimal numbers. **Adding and Subtracting Fractions** Children need to know that… • *When we add/subtract fractions with the same denominator, we add/subtract the numerator but the denominator stays the same.* • *We can use our knowledge of equivalent fractions to create pairs of fractions with common denominators. (Year 5)* • *Fractions with different denominators can be added/subtracted by finding a common denominator, using knowledge of equivalent fractions. (Year 5)* **Multiplying Fractions** Children need to know that… • *Fractions are a form of number, so can also be multiplied. (Year 5)* • *We can think of multiplying fractions by integers in two ways: (Year 5)* ○ ***Fractions of amounts:** The 'x' operation in a fraction question can also be thought of as meaning 'of'. We can use our knowledge of fractions of amounts (e.g. $\frac{1}{2}$ x 4 is the same as $\frac{1}{2}$ of 4.)* ○ ***Multiplication of the fraction:** We can think of this as repeated addition: the numerator will change, but the denominator will stay the same. (e.g. $\frac{1}{2}$ x 4 is the same as . $\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}$)* • *The distributive law will help us to multiply a mixed number by an integer. (Year 5)* • When we multiply two fractions, we multiply the numerator of the multiplicand by the numerator of the multiplier; and we multiply the denominator of the multiplicand by the denominator of the multiplier. • *This must be explained conceptually before introducing children to the algorithm– e.g. https://www.youtube.com/watch?v=x00zCdz_ixw* 	• *To find pairs of equivalent fractions by calculating efficiently using knowledge of factors and multiples, (Year 5)* keeping these manageable by using the lowest common multiple. • To find the simplest form of a fraction by dividing the numerator and denominator by the highest common factor. **Comparing and Ordering Fractions** Pupils need to know how… • *To compare unit fractions by using <, > and = (Year 3)* • *To compare fractions with the same denominator by using <, > and = (Year 3)* • *To compare fractions with the same numerator using <,> and = (Year 4)* • *To compare and order increasingly complex fractions. (Year 4)* • *To compare and order fractions with different denominators by using knowledge of equivalent fractions to find common denominators (when the denominators are all multiples of the same number). (Year 5)* • To compare and order fractions greater than 1. **Adding and Subtracting Fractions** Pupils need to know how… • *To add two fractions with the same denominator, by adding the numerators of both addends together (Year 3)* • *To subtract fractions with the same denominator by subtracting the numerator of the subtrahend from the numerator of the minuend. (Year 3)* • *To confidently add and subtract increasingly large unit and non-unit fractions with the same denominator (including adding three or more fractions). (Year 4)* • *To add and subtract fractions with different denominators by finding common denominators (when the denominators are all multiples of the same number). (Year 5)* • To add and subtract fractions with different denominators by finding common denominators using knowledge of lowest common multiples. **Multiplying fractions** Pupils need to know how… • *To multiply a proper number by an integer, supported by materials and diagrams. (Year 5)* • *To multiply a mixed number by an integer, supported by materials and diagrams. (Year 5)* • To multiply simple pairs of proper fractions. (e.g. $\frac{1}{4}$ x $\frac{1}{2}$ = $\frac{1}{8}$)	• ***Recognising equal parts is so important.** Recognising equality of parts is the fundamental knowledge required for multiplication, division and fractional reasoning. (Year 1)* • ***Fractions may look different but be describing the same amount.** Some fractions are equivalent. This means that they describe the same amount. They have been split into a different number of parts. **(Year 2)*** • ***We can only add/subtract numerators without doing anything else to the fractions when denominators are the same.** The parts must be the same size in order to be added together. (Year 3)* • ***When the numerator is the same, a larger denominator means a smaller fraction.** The denominator tells us how many parts it is split into. More parts means the parts will be smaller. (Year 3)* • ***We use a fraction wall to help us solve equivalence problems.** A fraction wall shows fractions side by side so it is very easy for us to draw a line and see which ones are bigger and which ones are smaller. (Year 3)* • ***A hundredth is a tenth divided by 10.** Tenths and hundredths also follow our base 10 system. There are ten hundredths in a tenth. (Year 4)* • ***The product can get smaller when we multiply an integer by a fraction.** A proper fraction is less than one whole. This means we are not making complete groups, but instead are splitting the whole into partial groups. This is why we don't say, early in our education, that multiplication always makes the product bigger.*

	Dividing Fractions Children need to know that… • When we divide an integer by a fraction, we turn the integer into a fraction (e.g. 6 = $\frac{6}{1}$), find the reciprocal of the second fraction (flip it), change the operation and then multiply the fractions together. • *This must be explained conceptually before introducing children to the algorithm – e.g. https://www.youtube.com/watch?v=fMVOwML7zTY*  		**Dividing Fractions** Children need to know how… • To divide a fraction by an integer. • To divide a pair of fractions. • To divide an integer by a fraction. To solve problems using their knowledge of fractions		

Vocabulary	**FRACTION**	A way of representing mathematically how many equal parts of a whole you have.	**PART**	A section of the whole. In fractions, parts must always be equal.	**WHOLE**	A total amount. This is the sum of all the parts. In fractions, the number 1 represents 1 whole.
	DENOMINATOR	The bottom number in a fraction. This describes the number of equal parts the whole has been split into.	**DIVIDING LINE**	The horizontal line which separates the numerator from the denominator.	**NUMERATOR**	The top number in a fraction. This describes the number of parts you have.
	HALF	When a whole has been split into two equal parts.	**QUARTER**	When a whole has been split into four equal parts.	**THIRD**	When a whole has been split into three equal parts.
	QUANTITY	A numerical amount.	**COMPARE**	Two meanings: a) to say what is the same or what is different. b) to identify the mathematical difference between numbers.	**EQUAL/ EQUIVALENT**	The same as.
	EQUIVALENT FRACTION	Fractions that represent the same amount/number but which look different.	**FRACTION WALL**	A pictorial representation of small fractions. This helps to find equivalent fractions.	**LIKE DENOMINATORS**	Denominators are the same
	LIKE NUMERATORS	Numerators are the same.	**UNIT FRACTION**	A fraction with a numerator of 1	**NON-UNIT FRACTION**	A fraction with a numerator larger than 1.
	TENTH	One part when a whole has been divided by 10	**HUNDREDTH**	One part when a whole has been divided by 100	**FRACTION FAMILY**	A group of equivalent fractions.
	COMMON DENOMINATOR	Like denominators.	**PROPER FRACTION**	A fraction less than 1 whole.	**IMPROPER FRACTION**	A fraction greater than a whole, written with a numerator larger than the denominator.
	MIXED NUMBER	A fraction greater than a whole which has been partitioned into the 'wholes', written as integers, and the part, written as a proper fraction.	**HIGHEST COMMON FACTOR**	The largest possible factor of two different numbers. This can be used to write a fraction in its simplest form.	**LOWEST COMMON MULTIPLE**	The smallest possible number which is a multiple of two different numbers.
	SIMPLIFYING	A process where the numerator and denominator are divided by the same divisor to create an equivalent fraction with a smaller numerator and denominator.	**FRACTION IN ITS SIMPLEST FORM**	The equivalent fraction with the smallest possible numerator and denominator, found by dividing the numerator and denominator by the highest common factor (HCF)		
Enrichment & wider development						

Year 6 - Spring 1

National Curriculum Milestones

Measure: Conversions
Pupils should be taught to:

- use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to 3 decimal places
- convert between miles and kilometres
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units [for example, mm^3 and km^3]
- solve problems involving the calculation and conversion of units of measure, using decimal notation up to 3 decimal places where appropriate

Algebra
Pupils should be taught to:

- use simple formulae
- generate and describe linear number sequences
- express missing number problems algebraically
- find pairs of numbers that satisfy an equation with 2 unknowns
- enumerate possibilities of combinations of 2 variables

Fractions, Decimals and Percentages
Pupils should be taught to:

- Associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, $\frac{3}{8}$]
- Identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places
- Multiply one-digit numbers with up to two decimal places by whole numbers
- Use written division methods in cases where the answer has up to two decimal places
- Solve problems which require answers to be rounded to specified degrees of accuracy
- Recall and use equivalences between simple fractions, decimals and percentages, including in different contexts

Revisited knowledge
New knowledge

Domains	**Declarative knowledge** (substantive knowledge)	**Procedural knowledge** (disciplinary knowledge)	**Conditional knowledge** (knowing the when and the why)

Converting units	**General Language of Measure**
	Children need to know that…
	• *To compare has two different meanings:*
	  ○ *to say how something is like or unlike something else.*
	  ○ *To describe which is larger and which is smaller (and by how many) (Year 2 Autumn 1)*
	• *Measurement is a precise way to describe the quantity of something (e.g. length, height, weight or capacity). (Year 1)*
	• *Measurements are always expressed in 2 parts, the quantity and the specific unit of measure. (Year 1)*
	
	Length - Conversions
	Children need to know that…
	• *A metre is a standard unit of measure used to measure moderately large distances. Distances measured in metres are written as _m. (Year 3)*
	• *A centimetre is a standard unit of measure used to measure short distances. Distances measured in centimetres are written as _cm. (Year 3)*
	• *A millimetre is a unit of measure used to measure very short distances. Distances measured in millimetres are written as _mm. (Year 3)*
	• *1 metre is equal to 100 centimetres and 1000 millimetres (Year 3)*
	• *1 centimetre is equal to 10 millimetres (Year 3)*
	• *A kilometre is a standard unit of measure used to measure very long distances. Distances measured in kilometres are written as _km (Year 4)*
	• *The prefix kilo means one thousand. (Year 4)*
	• *The prefix milli means one thousandth (Year 4)*
	• *The prefix centi means one hundredth. (Year 4)*
	• *Conversions: (Year 4)*
	  ○ *m → km (÷ 1000); km → m (x1000)*
	  ○ *cm → m (÷100); m → cm (x100)*
	  ○ *mm →cm (÷10); cm →mm (x10)*
	  ○ *mm →m (÷1000); m →mm (x1000)*
	
	Mass - Conversions
		Children need to know how…
		• *to convert between different units of related measure (for simple conversions – i.e. 5000 m; 7km). (Year 4)*
		• *to estimate amounts using rounding (Year 4)*
		• *to calculate with different measures selecting an appropriate operations and methods. (Year 4)*
		• *to compare different measures using <, > and =, converting if necessary.(Year 4)*
		• *to order different measures, converting if necessary. (Year 4)*
		• *to solve problems involving converting measures.(Year 4)*
		• *To convert between more complex units of related metric measure using knowledge of dividing by 10, 100 and 1000. (Year 5)*
		  ○ *m → km (÷ 1000); km → m (x1000)*
		  ○ *cm → m (÷100); m → cm (x100)*
		  ○ *mm →cm (÷10); cm →mm (x10)*
		  ○ *mm →m (÷1000); m →mm (x1000)*
		  ○ *g → kg (÷ 1000); kg → g (x1000)*
		  ○ *ml → l (÷ 1000); l → ml (x1000)*
		• *To use approximate equivalences between metric units and common imperial units. (Year 5)*
		• *To use all four operations to solve problems involving measures using decimal notation, including scaling. (Year 5)*
		• To convert measurements of length, mass, volume and time from smaller units of measure to larger units of measure using decimal notation up to 3dp.
			Children need to know …
			• *When a problem has mixed units of a measure, we need to convert the measurements to the same unit of measure in order to compare them. (Year 3)*
			• *When to multiply and when to divide when converting. (Year 4)*
			• *When a prefix gives you a clue about how to convert. (Year 4)*
			• To use a conversion chart/table to support converting between units.
			• To use the most appropriate unit of measure for a specific context.
			• To use a specific measurement tool for a specific context.
			• To apply knowledge of estimation to check the reasonableness of their calculations.
			• To apply their knowledge of conversion of measures to solve problems in real-life contexts.
			
			Children need to know why…
			• ***We have different units of measure.*** *Things can vary in size hugely. If we didn't have units of measure, we would have to measure very large numbers, which would be very difficult. (Year 1)*

Children need to know that…

- *Weight is a measure of 'heaviness'. Weight is affected by gravity. (Year 1)*
- *Mass is also a measure of 'heaviness'. It measures the specific amount of matter something contains. It is not affected by gravity. (Year 1)*
- *Both mass and weight can be measured in grams and kilograms. (Year 1)*
- *Grams are a small unit of measure, used to measure light things. (Year 1)*
- *Amounts measured in grams are written as Xg. (Year 1)*
- *Kilograms are a large unit of measure, used to measure heavy things. (Year 1)*
- *Amounts measured in kilograms are written as Xkg. (Year 1)*
- *A kilogram is a unit of mass equal to 1,000 grams (1kg = 1000g)(Year 3)*
- *The prefix kilo means one thousand (Year 4)*
- *Conversions: (Year 4)*
    - *g → kg (÷ 1000); kg → g (x1000)*

Capacity and Volume - Conversions

Children need to know that…

- *Capacity describes the container: the amount of something a container can hold. (Year 1)*
- *Volume describes the substance: the amount of space it takes up. (Year 1)*
- *Litres are a unit of measure used to measure larger amounts of liquids (both capacity and volume). (Year 1)*
- *Amounts measured in litres are written Xl. (Year 1)*
- *Millilitres is a unit of measure to measure smaller amounts of liquid (both capacity and volume). (Year 1)*
- *Amounts measured in millilitres are written Xml. (Year 1)*
- *A litre is a unit of capacity equal to 1,000 millilitres e.g. 1l = 1000ml (Year 3)*
- *The prefix milli means one thousandth (Year 4)*
- *Conversions: (Year 4)*
    - *ml → l (÷ 1000); l → ml (x1000)*

Metric and Imperial Measures

Children need to know that…

- *The metric measurement system is a decimal-based system of measurement, commonly used across the world today which includes (Year 5)*
    - ***Length:** Metres (including centimetre, kilometre, millimetres)*
    - ***Mass:** Kilograms (including grams)*
    - ***Capacity/volume:** Litres (including millilitres)*
- *The imperial measurement system is an older system of standard units which is less commonly used today (but is still seen in many places). This includes (Year 5)*
    - ***Length:** inches, feet, yards and miles*
    - ***Mass:** ounces, pounds, stone and tons*
    - ***Capacity/volume:** fluid ounces, pints and gallons*
- *Imperial measures do not always follow a base-10 conversion system. (Year 5)*
- *Some common conversions between metric and imperial units are (Year 5)*

Imperial unit	Number of smaller imperial units in it	Metric units (approx)
1 inch	None	2.5cm
1 foot	12 inches	30cm
1 yard	3 feet	91.4cm
1 mile	1760 yards	1.6km
1 ounce	None	28g
1 pound	16 ounces	453g
1 stone	14 pounds	6.4kg
1 pint	None	568ml
1 gallon	8 pints	4.5 litres

- *Scaling is when you are given information about something and then have to apply it to a smaller or larger quantity. (Year 5)*

- To convert accurately between miles and kilometres.
- To calculate, estimate and compare the volume of cubes and cuboids using standard units, including cm^3, m^3, mm^3 and km^3.
- To solve problems involving the calculation and conversion of units of measure, using decimal notation up to 3dp where appropriate.

- ***Units of measure have the prefixes they do.** Often the prefix is a clue to the conversion required as it describes the relationship between units. (Year 4)*
- ***We have to convert measures into the same measure.** Different units of measure describe different sized areas. Like with fractions that have different denominators, comparing measures with different units would be inaccurate as the units describe different amounts. (Year 4)*
- **We have separate standard measurement systems (imperial and metric).** Like with everything, time changes the conventions that we use for thinking about the world. The imperial system is an older system. As our Base 10 number system became more embedded and widely used, the world gradually transitioned to the metric system, which uses the Base 10 system at the heart. We generally use this as it allows us to communicate quickly and effectively with people across the world. However, we still use some imperial measures as they are widely used and embedded within our society.

Vocabulary

DESCRIBE	To say what something is like.	**MEASUREMENT**	A way of precisely describing the quantity of something. It is a process that uses numbers to make these descriptions.	**UNIT OF MEASURE**	Measurements are made by working out 'how many' of something are the same size. A unit of measure tells us what the 'something' is.
STANDARD UNIT OF MEASURE	A formally recognised and widely used unit of measure which has a consistent size and has measurement tools available for (e.g. cm)	**NON-STANDARD UNIT OF MEASURE**	When other objects in the world are chosen to measure the size of something.	**IMPERIAL MEASUREMENT**	An older system of measurement unit which is not wholly based on our Base 10 number system.

METRIC MEASUREMENT	The system of measurement used across the world today. This is largely based on our Base 10 number system.	**DISTANCE**	How far something is. Length and height are examples of distance.	**HEIGHT**	Vertical distance
LENGTH	Horizontal distance	**PERIMETER**	The distance around the outline of a 2D shape.	**SCALE**	A type of number line, often found on measuring tools. The type of scale depends on the interval between each mark. For example, most rules have a 1cm scale as there is 1cm between each mark.
MILLI-	A prefix meaning a thousandth of…	**CENTI**	A prefix meaning a hundredth of…	**KILO**	A prefix meaning a thousand.
MILLIMETRE	A tiny measure of distance, recorded with the unit notation mm. There are 1000mm in 1m. There are 10mm in 1cm	**CENTIMETRE**	A small measure of distance, recorded with the unit notation cm. There are 100cm in 1m.	**METRE**	A large measure of distance, recorded with the unit notation m.
KILOMETRE	A large measure of distance, recorded with the unit notation km. There are 1000 m in a kilometre.	**GRAM**	A small unit of measure for mass/weight	**KILOGRAM**	A large unit of measure for mass/weight.
MILLILITRE	A small unit of measure for volume and capacity.	**LITRE**	A large unit of measure for volume and capacity.	**ESTIMATE**	To make a 'sensible guess' based on your knowledge of and experience with number.

Algebra

Children need to know that…

- *Inverse means the opposite operation. Addition and subtraction are inverse operations. Multiplication and division are inverse operations. (Year 2)*
- *Negative numbers are numbers less than 0, expressed with a minus symbol (Year 4).*
- *The four operations are +, -, x and ÷ (all previous year groups)*
- Algebra is when letters and symbols are used to represent numbers.
- Algebraic statements can be expressions (mathematical number sentences which do not contain equality), equations (mathematical number sentences which show that two expressions are equal) or formulae (a way of expressing a key mathematical fact in words or symbols – e.g. calculating the diameter: "d=2r") .
- Algebra can also be used to describe a linear sequence of numbers where the difference between consecutive terms is consistent (either the same or changing by a consistent scaling factor).
- Sometimes, the letter/symbol may describe an unknown.
- Equality means that both sides of an equation represent the same value (e.g., 5+3=85 + 3 = 85+3=8).
- Inequalities are the relationships between two expressions which are not equal to one another. The symbols used for inequalities are <, >, ≤, ≥.
- To balance an equation, the same operation must happen on both sides.
- When calculating algebraic statements, we obey the order of operations (BIDMAS)
  - Brackets
  - Indices
  - Division
  - Multiplication
  - Addition
  - Subtraction

Algebraic notation

- Algebraic notation is used to represent complex ideas and relationships concisely.
- Each letter/symbol is a variable (can take a range of different values depending on the context).
- Algebraic expressions are made up of terms. Terms are elements within the expression. For example, with 2x + 4, the terms are *2x* and *+4*)
- Coefficients are written before a term and shows how many that term needs to be multiplied by. (e.g. with 2x, the coefficient is 2)
- **Addition:** shown normally, using the + symbol.
- **Subtraction** shown normally, using the – symbol.
- **Multiplication:** x symbol is not used. Symbols to be multiplied (letters/digits) are placed next to one another.
- **Division:** ÷ symbol is not used. Division is shown in fractional form, with the dividend above the dividing line (as the numerator) and the divisor below the dividing line (as the denominator).

For example:

Expression	Terms	What does it show?	Expression	Terms	What does it show?
2x + 4	2x +4	Multiply x by 2. **Then** add 4 to the product.	5n	5n	Multiply n by 5 OR n+n+n+n+n
xy	xy	Multiply x by y	2abc	2abc	Multiply a by b by c Then multiply the product by 2.
abc	abc	Multiply a by b by c.	$\frac{x}{3}$	$\frac{x}{3}$	x ÷ 3
p^2	p^2	Multiply p by p	$\frac{x}{n}$	$\frac{x}{n}$	x ÷ n
p^3	p^3	Multiply p by p by p	4(n+1)	4 n+1	n+1 Then multiply the sum by 4.
p^2q	p^2q	Multiply p by p by q	3a(a-b)	3a a-b	Multiply a by 3. Then a – b Then multiply the product for the first calculation by the difference of the second.

Children need to know how…

- To use the order of operations to solve more complex expressions in the correct order.
- To use simple formulae.
- To generate and describe linear number sequences algebraically.
- To express and solve missing number problems algebraically.
- To find pairs of numbers that satisfy an equation with 2 unknowns
- To enumerate possibilities of combinations of 2 variables

Children need to know when…

- To use a variable to represent an unknown number or value in a problem.
- To form an algebraic expression to represent a mathematical situation.
- To set up an equation to solve a problem where two expressions are equal.
- To identify and combine like terms to simplify an algebraic expression.
- To apply the correct mathematical operation (addition, subtraction, multiplication, division) in an algebraic context.
- To balance an equation by performing the same operation on both sides.
- To use inequality symbols to compare two expressions that are not necessarily equal.
- To identify and continue a sequence by recognising its pattern or rule.
- To identify a linear sequence by its constant difference between terms.
- To apply a formula to find a specific value, such as area or perimeter.

Children need to know why…

- **Mathematicians use algebra.** Algebra allows them to express complex ideas very quickly.

Algebraic Formulae

- Perimeter of a square: 4l
  - l = length of side
- Perimeter of a rectangle: 2(l+w)
  - l = length
  - w = width
- Perimeter of a regular polygon: nl
  - n = number of sides
  - l = length of side
- Radius/diameter of a circle: 2r = d
  - r = radius
  - d = diameter
- Area of a square: l^2
  - l = length of side
- Area of a rectangle: wl
  - l = length
  - w = width
- Area of a triangle $\frac{hb}{2}$
  - h = vertical height
  - b = base
- Volume of a cuboid: lwh
  - l = length
  - w = width
  - h = height

Vocabulary

ALGEBRA	when letters and symbols are used to represent numbers	**VARIABLE**	: A symbol (usually a letter) that represents an unknown number or value.	**SYMBOL**	An image (e.g. letter) used to represent meaning in mathematics.
EXPRESSION	A combination of numbers, variables, and operation symbols	**EQUATION**	A mathematical statement that shows that two expressions are equal	**TERM**	A single element of an algebraic expression (e.g. ab)
COEFFICIENT	A number that a variable is multiplied by in a term (e.g. **2**a)	**CONSTANT**	A fixed value that does not change	**OPERATION**	Mathematical processes such as addition (+), subtraction (-), multiplication (×), and division (÷).
ORDER OF OPERATIONS	The rules which tell us which order we should solve an expression with multiple operations. BIDMAS (brackets, indices, multiplication, division, addition, subtraction)	**SOLVE**	To find the value of the variable that makes the equation true.	**SUBSTITUTE**	To replace a variable with a given number in an expression or equation.
BALANCE	To keep both sides of an equation equal by performing the same operation on both sides.	**INEQUALITY**	A mathematical symbol that compares two expressions and shows that they are not necessarily equal. Includes <,>, ≤, ≥	**EQUALITY**	A mathematical symbol used to show two expressions are equal. =
SEQUENCE	An ordered list of numbers that follow a specific pattern or rule	**LINEAR SEQUENCE**	A sequence in which the difference between consecutive terms is constant	**CONSECUTIVE**	One after another.

Fractions, decimals and percentages

Representing Decimal Fractions

Children need to know that…

- *A fraction represents part of a whole. (Year 1)*
- *When we write a fraction, the bottom number describes the total number of **equal** parts that the whole has been split into. This is called the denominator The top number describes the number of parts you have. This is called the numerator. (Year 2)*
- *The straight line between the numerator and the denominator is called the dividing line. (Year 2)*
- *A proper fraction is a fraction < 1 (Year 5 Spring 2)*
- *An improper fraction is a fraction > 1. Improper fractions can also be expressed as mixed numbers. (Year 5 Spring 2)*
- *A tenth is 1 part out of 10. Tenths arise from dividing an object into 10 equal parts. (Year 3)*
- *A hundredth is 1 part out of 100. Hundredths arise from dividing a whole into 100 equal parts. Hundredths arise from dividing a tenth into 10 equal parts. (Year 4)*
- *A thousandth is one part out of 1,000. Thousandths arise from dividing a whole by 1,000; a tenth by 100 or a hundredth by 10. (Year 5)*
- *Decimal numbers are another way of showing fractions of a whole (Year 4)*
- *Decimals represent fractions with denominators that are a power of 10. (Year 5)*
- *With decimal numbers, our place value grid extends to the right, past the ones – see below. (Year 4)*

- *To show that the digits are now decimals (parts of a whole), a decimal point is placed between the ones column and the tenths column. (Year 4)*
- *The number of digits after the decimal point is called decimal places. We can describe decimal numbers by saying how many dps (decimal places) they have. For example, 2.12 is a number with 2dps. (Year 4)*
- *The decimal point should be written on the line between the squares in your book, to show it is just a visual placeholder, not a column with numerical value. (Year 4)*

Representing Fractions

Pupils need to know how…

- *To count up and down in tenths, hundredths and thousandths. (Year 5)*
- *To find a tenth, hundredth and thousandth by dividing the whole by 10, 100 or 1000 (Year 5)*
- *To recognise the value of decimal digits up to 3dp (Year 5).*
- *To convert between fractions and decimals by recognising and writing decimal equivalents of any number of tenth, hundreds and thousandths. (Year 5)*
- *To write fractional numbers (with tenths/hundredths/thousandths) greater than one whole as mixed numbers and decimals. (Year 5)*
- *To convert between fractions and decimals by recognising and writing key fraction/decimal equivalences $\frac{1}{4}$=0.25, $\frac{1}{2}$=0.5, $\frac{3}{4}$=0.75, $\frac{1}{5}$=0.2, $\frac{2}{5}$=0.4, $\frac{3}{5}$=0.6, $\frac{4}{5}$=0.8. (Year 5)*
- *To multiply and divide any number by 10, 100 or 1000, when the answer has up to 3dp. (Year 5)*

Children need to know when…

- *It is easier to present a fractional amount as a fraction or a decimal.*
- *They are likely to see/use decimal numbers in real life.*
- *Rounding decimals may help with estimating.*
- *It is most appropriate to present fractional amounts as fractions, decimals or percentages.*
- *Converting between fractions, decimals and percentages is necessary to solve problems.*
- *Percentages are used in real-life contexts.*
- *Visual representations will support them to solve problems involving fraction, decimal and percentage equivalence.*
- To use specific strategies to calculate percentages of amounts.
- To provide a remainder to a division calculation as a decimal.
- To apply knowledge of fractions, decimals and percentages to solve real-world problems, such as calculating discounts, comparing quantities and finding proportions.

Children need to know why…

- **Many measures use decimal rather than fraction notation.** Many measurement units use Base 10

- *Tenths are shown in the tenths column: 0.1 = $\frac{1}{10}$ (Year 4)*
- *Hundredths are shown in the hundredths column: 0.01 = $\frac{1}{100}$ (Year 4)*
- *Thousandths are shown in the thousandths column: 0.001 = $\frac{1}{1000}$ (Year 5)*
- *Both fractions and decimals can be used to express fractional numbers greater than one whole. (Year 4)*
    - *Decimal numbers: The integer parts are shown to the left of the decimal point; the fractional parts are shown in the place value columns to the right of the dp (e.g. 3 wholes, 1 tenth and 7 hundredths would be written 3.17)*
    - *Fractions: a fraction with wholes and parts is called a mixed number. The integer (whole number) is written with a large digit and the fractional part is shown as a fraction and written much smaller. (e.g. 3 wholes, 1 tenth and 7 hundredths would be written as $3\frac{17}{100}$)*
- *Decimal equivalents are decimal numbers that have the same value (e.g. 0.5 and 0.50) (Year 4)*
- *A place holder 0 is the use of the digit 0 to mark a column in a number which has no value (Year 1)*
- *Most simple fractions can be converted to decimal numbers. (Year 5)*

Rounding Decimals
Children need to know that…
- *Rounding numbers makes them 'easier' to use or understand whilst keeping the number close to its original value.*
- *Rounding is a mathematical way of estimating number. (Year 4)*
- *We can round to any place value column. (Year 4)*
- *When rounding, you need to find the place value you are rounding to. This is called your target digit. (Year 4)*
- *You then need to look at the next smallest column. If this is 5 or more, you round up. If this is 0-4 you round down. (Year 4)*
- *When you round up, the target digit increases by one; the digits in larger place value columns stay the same; the digits in smaller place value columns become 0. (Year 4)*
- *When you round down, the target digit stays the same; the digits in larger place value columns stay the same; the digits in smaller place value columns become 0. (Year 4)*

Comparing and Ordering Decimals
Children need to know that…
- *< is a mathematical symbol which means less than (Year 2)*
- *> is a mathematical symbol which means more than. (Year 2)*
- *= is a mathematical symbol which means equal to (Year R)*
- *Equal means the same (Year R)*
- *When comparing and ordering numbers, we have to look at the largest place value column first. (Year 3)*
- *It is important to organise our numbers so it is easy to compare place value columns, for example using the squares in our books. (Year 3)*

Dividing to create decimal numbers
Children need to know that…
- *When we divide a number by 10, the digits move one column to the right, becoming ten times smaller. (Year 4)*
- *When we divide a number by 100, the digits move two columns to the right, becoming one hundred times smaller. (Year 4)*
- *When we divide a number by 1000, the digits move three columns to the right, becoming one thousand times smaller. (Year 5)*
- We can convert more difficult fractions to decimals by dividing the numerator by the denominator (e.g. $\frac{6}{7}$ = 6 ÷ 7)

Percentages
Children need to know that…
- *A percentage is another way of writing a fraction with a denominator of 100 (e.g. $\frac{25}{100}$ = 25 %) (Year 5)*
- *Percentages are shown with the % symbol. (Year 5)*
- *Percentage means "parts out of 100". (Year 5)*
- *We can convert between fractions, decimals and percentages by looking for common denominators of 10 and 100. (Year 5)*
- *Common fraction/decimal/percentage equivalents which we need to learn by heart are (Year 5)*

Fraction	*Decimal*	*Percentage*
1	*1*	*100%*
$\frac{1}{10}$	*0.1*	*10%*
$\frac{1}{100}$	*0.01*	*1%*
$\frac{1}{1000}$	*0.001*	*0.1%*
$\frac{1}{2}$	*0.5*	*50%*
$\frac{1}{4}$	*0.25*	*25%*
$\frac{3}{4}$	*0.75*	*75%*
$\frac{1}{5}$	*0.2*	*20%*

Rounding Decimals
Children need to know how…
- *To round decimal numbers with 1dp to the nearest one whole. (Year 4)*
- *To round decimals with 2 or 3dp to the nearest whole. (Year 5)*
- *To round decimals with 2 or 3dp to the nearest tenth. (Year 5)*
- To solve problems which require numbers to be rounded to specified degrees of accuracy.

Comparing and Ordering Decimals
Children need to know how…
- *To compare decimal numbers with the same number of decimal places (up to 2 dp) using <,>, = (Year 4)*
- *To order decimal numbers with the same number of decimal places (up to 2 dp) in ascending or descending order. (Year 4)*
- *To compare decimal numbers (up to 3dp) using <,>,=, including when the numbers have a different numbers of decimal places. (Year 5)*
- *To order decimal numbers (up to 3dp) in ascending and descending order, including when the numbers have a different numbers of decimal places. (Year 5)*

Dividing to create decimal numbers
Children need to know that…
- *To divide any number by 10, 100 or 1000 when the quotient has up to 3dps. (Year 5)*
- To convert more complex fractions to decimals using division (e.g. $\frac{6}{7}$ = 6 ÷ 7)

Percentages
Children need to know how…
- *To recognise the % symbol and understand how this relates to 'parts out of 100'. (Year 5)*
- *To write percentages as fractions with a denominator of 100 and as a decimal. (Year 5)*
- *To write fractions and decimals with any number of tenths, hundredths and thousandths as a %. (Year 5)*
- *To write fraction and decimal equivalents for $\frac{1}{2}, \frac{1}{4}, \frac{3}{4}, \frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}$ as a %. (Year 5)*
- *To solve problems which require knowing fraction, decimal and percentage equivalents for any number of tenths, hundredths and thousandths. (Year 5)*
- *To solve problems which require knowing fraction, decimal and % equivalents for $\frac{1}{2}, \frac{1}{4}, \frac{3}{4}, \frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}$. (Year 5)*

equivalences which are easier to show and calculate with in decimal form.

$\frac{2}{5}$	*0.4*	*40%*
$\frac{3}{5}$	*0.6*	*60%*
$\frac{4}{5}$	*0.8*	*80%*

- Because fractions, decimals and percentages are all different representations of the same concept, they can be converted flexibly.
- Percentages can be used to find fractions of quantities.
    - There are lots of different strategies to do this, which start by finding specific percentages of the whole. Common strategies include:
        - Finding 1%: ÷100
        - Finding 10%: ÷10
        - Finding 50%: ÷2
        - Finding 25%: ÷4
        - Finding 5%: ÷20 or ÷10 then ÷2

- To efficiently calculate percentages of amounts and solve problems involving this knowledge.

Using decimals in calculation
Children need to know how…

- To multiply one-digit numbers with up to 2dps by a whole number using a formal written method or mental methods.
- To divide numbers with up to four digits by a one or two digit number, where the answer has a remainder, giving the remainder as a decimal answer.

Vocabulary

NUMBER	An abstract way of representing a quantity (e.g. 2, 26, fifty-nine, $\frac{1}{2}$, 0.322)	**NUMERAL**	Words or symbols used to represent numbers, made up of digits.	**DIGIT**	The ten single symbols 0-9, used to represent numbers when placed in sequence.
VALUE	How much something is worth. In representation of number, the position of a digit in a numeral determines its value.	**PLACE VALUE CHART**	A picture/diagram used to help represent the value of digits in numbers.	**ESTIMATE**	To make a 'sensible guess' based on your knowledge of and experience with number.
ONE DIGIT NUMBER	A numeral which only contains one digit.	**TWO DIGIT NUMBER**	A numeral which contains two digits. The first digit has a value of tens.	**THREE DIGIT NUMBER**	A numeral which contains three digits. The first numeral has a value of hundreds.
FOUR DIGIT NUMBER	A numeral which contains four digits. The first numeral has a value of thousands.	DECIMAL POINT	The 'dot' placed between the ones and tenths column to show the shift from integer to fractional amounts.	DECIMAL PLACES	The number of digits after the decimal point in a given numeral.
THOUSANDS	A digit value where the digit represents one-thousand-times the quantity. There are 10 hundreds in a thousand. There are 100 tens in a hundred; there are 1000 ones in a hundred.	**HUNDREDS**	A digit value where the digit represents one-hundred-times the quantity. There are 10 tens in a hundred; there are 100 ones in a hundred.	**TENS**	A digit value where the digit represents ten-times the quantity. There are 10 ones in a ten.
ONES	Where the digit represents the quantity exactly.	**TENTH**	One part when a whole has been divided by 10.	**HUNDREDTH**	One part when a whole has been divided by 100
THOUSANDTH	One part when a whole has been divided by 1,000.	**COMPARE**	Two meanings: a) to say what is the same or what is different. b) to identify the mathematical difference between numbers.	**EQUAL**	The same as.
GREATER THAN >	When the first number is more than the second number. Can be shown by the greater than symbol >	**LESS THAN <**	When the first number is less than the second number. Can be shown by the less than symbol.	**ORDER**	To arrange numbers by their numerical value.
ASCENDING ORDER	Arranging numbers from smallest to largest.	**DESCENDING ORDER**	Arranging numbers from largest to smallest.	**PART**	A section of the whole.
WHOLE	A total amount. This is always the sum of the parts.	**ROUNDING**	To alter a number to be less exact by taking it to the nearest 'one' of a specified place value column. This makes it more convenient for calculating with.	**EQUAL/ EQUIVALENT**	The same as.
PERCENTAGE	Parts out of 100.	**%**	The symbol used to represent percentage.	**PLACE HOLDER ZERO**	Where a zero is placed in a place value column to show there are 0 of that value within the number. This is important to ensure that digits are seen in the correct place value column.

Enrichment & wider development

Year 6 - Spring 2

National curriculum milestones
Measure: Perimeter, Area and Volume
Pupils should be taught to:

- Recognise that shapes with the same areas can have different perimeters and vice versa
- Recognise when it is possible to use formulae for area and volume of shapes
- Calculate the area of parallelograms and triangles
- Calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units [for example, mm^3 and km^3]

Geometry: Position and Direction
Pupils should be taught to:

- describe positions on the full coordinate grid (all 4 quadrants)
- draw and translate simple shapes on the coordinate plane, and reflect them in the axes

Revisited knowledge
New knowledge

Domains	**Declarative knowledge** (substantive knowledge)	**Procedural knowledge** (disciplinary knowledge)	**Conditional knowledge** (knowing the when and the why)

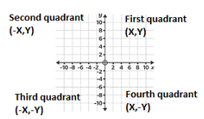
Perimeter, Area and Volume	**Perimeter**
	Children need to know that…
	• *Measurement is a precise way to describe the quantity of something (e.g. length, height, weight, capacity). (Year 1)*
	• *There are different tools used to measure distance. (Year 2)*
	• *Many rulers have two scales (one on either side). One scale is divided into cm. The other scale is divided into mm. (Year 3)*
	• *Millimetre is a unit of measure used to measure very short distances. Distances measured in millimetres are written as _mm. (Year 3)*
	• *There are 10 millimetres in 1 centimetre (Year 3)*
	• *There are 1,000 millimetres in 1m (Year 3)*
	• *There are 100cm in 1m. (Year 1)*
	• *Perimeter is the distance around the outside of a shape (Year 3)*
	• *Perimeter can be expressed algebraically (Year 6 Spring 1)*
	  ◦ *Perimeter of a square: 4l (Year 6 Spring 1)*
	  ◦ *l = length of side*
	  ◦ *Perimeter of a rectangle: 2(l+w) (Year 6 Spring 1)*
	  ◦ *l = length*
	  ◦ *w = width*
	  ◦ *Perimeter of a regular polygon: nl (Year 6 Spring 1)*
	  ◦ *n = number of sides*
	  ◦ *l = length of side*
	
	Area
	Children need to know that…
	• *An array is a way of showing multiplication by arranging dots or counters into rows and columns (Year 1)*
	• *Area is a measure of the amount of space within the perimeter of a 2d shape. (Year 4)*
	• *Area is measured in square units (e.g. mm^2, cm^2, m^2) (Year 4)*
	• *Square units work by dividing a space into many small squares. In a square unit, each side of a tiny square measures one of that unit. (e.g. when measuring in cm^2, each side of each tiny square within the space would be 1cm long.) (Year 4)*
	• *We can calculate the area of a rectangle or square by multiplying the length by the width. (Year 5/6)*
	  ◦ *The formulae to calculate the area of a square is l^2*
	  ◦ *The formulae to calculate the area of a rectangle is lw*
	• *A rectilinear shape is a 2D shape made up of squares and rectangles. (Year 4)*
	• *We can find the area by counting squares within a rectilinear shape. This works very much like an array in multiplication. (Year 4)*
	• *A composite or compound shape is any shape made of two or more geometric shapes. (Year 5)*
	• *We can calculate the area of composite rectilinear shapes by breaking them down into smaller squares and rectangles. (Year 5)*
	• *An irregular shape has at least one unequal sides or unequal angle. (Year 5)*
	• *Area can be expressed algebraically (Year 6 Spring 1)*
		Perimeter
		Children need to know how…
		• *To describe distance using appropriate mathematical language (all previous)*
		• *To measure distance accurately using non-standard units of measure and standard units of measure, including using a ruler precisely (all previous)*
		• *To identify the most appropriate unit of measure (all previous)*
		• *To estimate lengths (all previous)*
		• *To convert to find equivalent units of measure by multiplying and dividing by 10, 100 and 1,000 (Year 5)*
		• *To measure the perimeter of more complex rectilinear shapes by measuring each side and adding them together. (Year 4)*
		• *To calculate the perimeter of more complex rectilinear shapes not draw to scale by adding lengths together. (Year 4)*
		• *To efficiently calculate the perimeter of squares and rectangles using basic algebraic reasoning based on well-established knowledge of the properties of 2D shapes (e.g. square = 4 x length; rectangle = 2 x height + 2 x length) (Year 5)*
		• *To measure and calculate the perimeter of composite rectilinear shapes in standard units of measure (e.g. cm and m)(Year 5)*
		• *To begin to use the algebraic formulae to remember how to calculate the perimeter of squares "4l" and rectangles "2(l+w)". (Year 5)*
		• To recognise when it is possible to use a formula to calculate the perimeter of a shape.
		
		Area
		Children need to know how…
		• *To find the area of rectilinear shapes (not drawn to scale) by counting squares. (Year 4)*
		• *To give the area of rectilinear shapes using the correct unit (cm^2 or m^2) (Year 4)*
		• *To calculate the area of rectangles (including squares) using standard units (e.g. cm^2 and m^2). (Year 5)*
		• *To compare the area of rectilinear shapes. (Year 5)*
		• *To estimate the area of irregular shapes using knowledge of halves and quarters. (Year 5)*
		• To recognise when it is possible to use a formula to calculate the area of a shape.
		• To prove that shapes with the same area can have different perimeters (and vice versa).
		• To calculate the area of a parallelogram using the formula 'bh'
			Children need to know when…
			• *They may need to convert a unit of measure to be able to calculate with it. (Year 3)*
			• *When they need to measure all sides of a shape to find the perimeter and when they can use their knowledge of calculation and properties of shapes. (Year 3).*
			• *When to apply knowledge of addition and subtraction to solve perimeter problems (including finding the length of missing sides) (Year 3).*
			• *A simple algebraic formula (expanded) can help them calculate the perimeter of a shape. (Year 4)*
			• *A problem is asking us to calculate area: how much space is available on a surface, how much material is needed to cover a surface, to compare the size of different shapes. (Year 4)*
			• *To use different units of measure based on the size of the space/distance being measured. (Year 4)*
			• *To break a rectilinear shape into smaller rectangles to help solve perimeter and area problems. (Year 5)*
			• *To apply their knowledge of measurement in real-life contexts. (Year 5)*
			• To use a formula to help calculate area, perimeter or volume of shapes.
			
			Children need to know why…
			• ***Careful, accurate measurement is important.*** *To ensure that we use exactly the right amount of something. Getting this wrong can have significant consequences (e.g. baking, medicine, sports). (Year 1)*
			• ***We have different units of measure.*** *Things can vary in size hugely. If we didn't have units of measure, we would have to measure very large numbers, which would be very difficult. (Year 1)*
			• ***Rulers have two different scales.*** *Both mm and cm are common units of measure. Having both on a ruler lets us measure in both. (Year 3)*
			• ***We need to find the perimeter of a shape****. This can both help us in real life contexts (e.g. knowing how much fence*

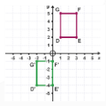
	• *Area of a square: l^2 (Year 6 Spring 1)*
	  ○ *l = length of side*
	• *Area of a rectangle: lw (Year 6 Spring 1)*
	  ○ *l = length*
	  ○ *w = width*
	• *Area of a triangle: $\frac{bh}{2}$ (Year 6 Spring 1)*
	  ○ *h = vertical height*
	  ○ *b = base*
	• Area of a parallelogram: bh
	  ○ h = vertical height
	  ○ b = base
	
	Volume
	Children need to know that…
	• *Cubic units are another type of unit used to measure volume (e.g. 5cm³) (Year 5)*
	• *To measure volume of a cuboid in cubic units, you multiply length x width x height. (Year 5)*
	  ○ *Algebraically, this is represented lwh (Year 6 Spring 1)*
		• To calculate the area of a triangle using the formula $\frac{hb}{2}$
		
		Volume
		Children need to know how…
		• *To estimate volume in cm³ by using blocks to build cubes and cuboids(Year 5)*
		• *To estimate capacity using water. (Year 5)*
		• To recognise when it is possible to use a formula to calculate the volume of a shape.
		• To calculate, estimate and compare the volume of cubes and cuboids using standard units.
		
		To solve measure problems involving all four operations
			to buy) but is also important to be able to calculate area later on in Mathematics (Year 3)
			• ***We need to be able to calculate the area.*** *The area gives us a measure of the size of a space. This can help us work out how much material we need to cover it, or whether things will fit in this space. (Year 5)*
			• ***We can learn formulae to help us remember how to calculate area and perimeter.*** *Because geometric shapes follow regular rules, we can find short ways of reminding us of those rules.* (Year 5)

Vocabulary

DESCRIBE	To say what something is like.	**MEASUREMENT**	A way of precisely describing the quantity of something. It is a process that uses numbers to make these descriptions.	**UNIT OF MEASURE**	Measurements are made by working out 'how many' of something are the same size. A unit of measure tells us what the 'something' is.
STANDARD UNIT OF MEASURE	A formally recognised and widely used unit of measure which has a consistent size and has measurement tools available (e.g. cm)	**NON-STANDARD UNIT OF MEASURE**	When other objects in the world are chosen to measure the size of something.	**DISTANCE**	How far something is. Length and height are examples of distance.
HEIGHT	Vertical distance	**LENGTH**	Horizontal distance	**PERIMETER**	The distance around the outline of a 2D shape.
METRE	A large measure of distance, recorded with the unit notation m.	**CENTIMETRE**	A small measure of distance, recorded with the unit notation cm. There are 100cm in 1m.	**MILLIMETRE**	A tiny measure of distance, recorded with the unit notation mm. There are 1000mm in 1m. There are 10mm in 1cm
SCALE	A type of number line, often found on measuring tools. The type of scale depends on the interval between each mark. For example, most rules have a 1cm scale as there is 1cm between each mark.	**AREA**	A measure of the space within a 2D shape.	**SQUARE CENTIMETRE cm²** **SQUARE METRE m²**	Units of measure for area.
LENGTH	The distance from the bottom to the top of a quadrilateral/shape.	**WIDTH**	The distance from the left to the right.		

Position and Direction

Children need to know that…
• *Position describes where something or someone is; direction means the line along which something moves, lies or points; movement means a change of position or direction. (Year 1)*
• *Rotation is when something turns or spins around a point. Sometimes, this point is located at the centre. (Year 2)*
• *Clockwise is the direction in which the hands of a clock turn. It is a turn to the right. (Year 2)*
• *A polygon is a shape with three or more straight sides (Year 3).*
• *A coordinate grid is a way of organising space. (Year 4)*
• *Coordinate grids have two axes: a horizontal (x) axis and a vertical (y) axis. (Year 4)*
• *Coordinate grids allow us to describe exact locations precisely: coordinates are the way of describing this location. (Year 4)*
• *Coordinates consist of 2 numbers separated by a comma. The coordinates are contained within a pair of brackets. (Year 4)*
  ○ *The first number shows the position on the x axis and describes an imaginary vertical line originating from this point on the x axis.*
  ○ *The second number shows the position on the y axis and describes an imaginary line originating from this point on the y axis.*
  ○ *The position where these two lines intersect is the position described by the coordinate pair.*
• *In a one-quadrant coordinate grid the x and y axes meet at the origin (0) and only have positive values. (Year 4)*
• *Most coordinate grids have narrow or faint horizontal and vertical lines connecting the numbers on each axis. (Year 4)*
• *Our coordinate grid actually has four quadrants. This is because the X and Y axes also have negative values. (Year 5)*
• *When a point is within the negative quadrants, this will be recorded within coordinates as a negative number. (Year 5)*
 
• *When we put a dot at a location on a coordinate grid described by a pair of coordinates, this is called plotting. (Year 4)*
• *A transformation is where a shape or point on a coordinate grid is changed in some way. (Year 4)*
	Children need to know how…
	• *To describe the position of a point or shape shown on a grid showing the first quadrant using coordinates. (Year 4)*
	• *To plot specified points on a coordinate grid in the first quadrant from given coordinates. When these points create a polygon, join these with a ruler to create the final polygon. (Year 4)*
	• *To describe the translation of a point or shape on a coordinate grid using positional language (e.g. to the left/right and up/down) and with coordinates (e.g. 2,-1) (Year 4)*
	• *To translate a shape within the first quadrant of a coordinate grid from directions given in positional language and with coordinates. (Year 4)*
	• *To describe the position of a point or shape shown on a four-quadrant grid using coordinates. (Year 5)*
	• *To identify and describe the position of a shape on a four-quadrant grid following a reflection. (Year 5)*
	• *To reflect a shape in a horizontal or vertical mirror line. (Year 5)*
	• *To identify and describe the position of a shape on a four-quadrant grid following a translation. (Year 5)*
	• *To translate shape accurately on a four quadrant grid. (Year 5)*
	• To reflect shapes in a diagonal line.
	• To rotate shapes a given number of right angles clockwise or anticlockwise.
		Children need to know when…
		• *A number in a coordinate is referring to the x axis and when it is referring to the y axis. (Year 4)*
		• *A translation has occurred. (Year 4)*
		• *Jottings may help them to describe or complete a translation. (Year 4)*
		• *A transformation will cross the axes. (Year 5)*
		• *A coordinate will need to include a negative number. (Year 5)*
		• *They will need to give a location as a set of coordinates. (Year 5)*
		• *To apply this knowledge to solve real-life problems including map-reading and navigation. (Year 5)*
		• *To estimate distances between locations using scale. (Year 5)*
		
		Children need to know why…
		• ***The x axis is always given first.*** *This is a mathematical convention. (Year 4)*
		• ***Completed polygons must be drawn with a ruler.*** *Geometric shapes are shapes with straight sides. Therefore, these must be drawn carefully. (Year 4)*
		• ***Shapes do not change when they are reflected and translated.*** *These are changes of position only. (Year 5)*

	• *Translation is a type of transformation when a point or shape is moved (either horizontally or vertically) from one position to another. Every point in a translated shape moves the same amount in the same direction. (Year 4*  • *A translation can be described using positional language (e.g. 3 right, 2 down) or coordinates (+3,-2) (Year 4)* • *We always describe movement on the x axis first. (Year 4)* • *Another type of **transformation** is reflection, where a shape is 'flipped' along a mirror line, creating a perfectly symmetrical image. (Year 5)*  • *When a shape is reflected in a mirror line, the original and reflected points will be an equal distance from the mirror line, in opposite directions. (Year 5)* • *Shapes can be reflected along the axes of a grid, or along a specified horizontal or vertical line. (Year 5)* • *Reflected shapes will be congruent (the same shape and size) (Year 5)* • Rotation is where a shape 'spins' around a given point. Rotated shapes will be congruent.					
Vocabulary	**COORDINATE GRID**	A type of mathematical diagram where a horizontal and vertical axis (line) meet at a right angle. Each axis has a scale. Divisions on the axis have faint vertical/horizontal lines emerging from them, which create a regular grid pattern.	**X AXIS**	The horizontal axis (fixed reference line with a scale on a grid).	**Y AXIS**	The vertical axis (fixed reference line with a scale on a grid).
	COORDINATE	A way of mathematically describing an exact position on a coordinate grid. Coordinates are given in the following format: (#,#). The first number (#) shows the position on the x axis. The second number shows the position on the y axis.	**TRANSFORMATION**	A change to the size or position of a geometric shape (such as a reflection, translation, rotation or enlargement)	**TRANSLATION**	The movement of a shape from one position to another vertically/horizontally.
	REFLECTION	When a shape is 'flipped' in a mirror line, with the reflected points an equal distance from the mirror line in an opposite direction.	**FIRST QUADRANT**	The first of four parts created when an x and y axis cross. The first quadrant contains the positive scales for both the x and the y axis and is located on the top right of a four-quadrant coordinate grid.	**ORIGIN**	The point where the x and y axis meet.
	SECOND QUADRANT	The second of four parts created when an x and y axis cross. The second quadrant contains the negative X axis scale and the positive Y axis scale and is located on the top left of a four quadrant coordinate grid.	**THIRD QUADRANT**	The third of four parts created when an x and y axis cross. The second quadrant contains the negative X axis scale and the negative Y axis scale and is located on the bottom left of a four-quadrant coordinate grid.	**FOURTH QUADRANT**	The fourth of four parts created when an x and y axis cross. The second quadrant contains the positive X axis scale and the negative Y axis scale and is located on the bottom right of a four-quadrant coordinate grid.
Enrichment & wider development						

Year 6 Summer 1

National curriculum milestones
Ratio and Proportion
Pupils should be taught to:

- Solve problems involving the relative sizes of 2 quantities where missing values can be found by using integer multiplication and division facts
- Solve problems involving the calculation of percentages [for example, of measures and such as 15% of 360] and the use of percentages for comparison
- Solve problems involving similar shapes where the scale factor is known or can be found
- Solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

Statistics
Pupils should be taught to:

- Interpret and construct pie charts and line graphs and use these to solve problems
- Calculate and interpret the mean as an average

Revision

Revisited knowledge
New knowledge

Domain	**Declarative knowledge** (substantive knowledge)	**Procedural knowledge** (disciplinary knowledge)	**Conditional knowledge** (knowing the when and the why)
Ratio and proportion	Children need to know that… • Ratio is a comparison of two quantities or amounts, which shows how one quantity is related to the other. • It is typically expressed in the form as a:b • Ratios can be written in different (e.g. 2:3 is the same as 2/3. • Equivalent ratios represent the same comparison but may be expressed differently (e.g., 1:2 and 3:6 are equivalent ratios). • Proportion shows that the relationship between ratios remains consistent across different scales or quantities. • It can be written as a/b=c/d or in cross-multiplication form a:b = c:d • Solving proportions involves finding the missing value when three out of four terms are known. • Proportion is used extensively in scaling, resizing, and comparing quantities in various contexts.	Children need to know how… • To solve problems involving the relative sizes of 2 quantities where missing values can be found by using integer multiplication and division facts • To solve problems involving the calculation of percentages and the use of percentages for comparison • To solve problems involving similar shapes where the scale factor is known or can be found • To solve problems involving unequal sharing and grouping using knowledge of fractions and multiples	Children need to know when… • It is appropriate to use ratio notation to compare quantities or amounts. • To recognise and apply equivalent ratios to solve problems • To interpret and use ratios in real-world contexts, such as recipes, maps, and scales. • To scale up or down quantities using ratios (e.g., increasing a recipe by doubling all ingredients). • To apply proportions to solve problems involving scaling, resizing, or comparing quantities. • When to apply their understanding of proportion in practical scenarios, such as scaling drawings, solving word problems, or adjusting quantities based on a given ratio. • To convert between ratios and percentages or fractions to solve problems effectively. • To interpret and represent proportional relationships using tables, graphs, or diagrams.

Vocabulary						
	RATIO	An expression of the relationship between two quantities, often expressed 2:1	**PROPORTION**	An equation that states two ratios are equal	**ENLARGEMENT**	Increasing the size of a shape or figure proportionally.
	EQUIVALENT RATIO	Ratios that express the same comparison but may be written in different forms	**PROPORTIONAL RELATIONSHIP**	A relationship between two quantities where their ratio is constant.	**REDUCTION**	Decreasing the size of a shape or figure proportionally
	PART-TO-WHOLE RATIO	A ratio that compares a part of a quantity to the whole quantity (e.g., the ratio of boys to girls in a class).	**DIRECTLY PROPORTION**	A relationship where one quantity increases or decreases in proportion to another (e.g., if aaa doubles, bbb doubles as well).	**PERCENTAGE INCREASE/DECREASE**	The change in quantity expressed as a percentage of the original quantity
	SIMPLIFY	To reduce a ratio to its simplest form by dividing both parts by their highest common factor	**INVERSE PROPORTION**	A relationship where one quantity increases as another decreases in proportion (e.g., if aaa doubles, bbb halves).	**SCALE FACTOR**	A number that scales or enlarges a ratio proportionally (e.g., multiplying or dividing both parts of a ratio by the same number).
	RATE	A special type of ratio that compares two quantities with different units (e.g., speed, unit rates).	**UNIT RATE**	A rate that compares a quantity to one unit of another quantity (e.g., miles per hour).	**SCALE**	To change the size of a ratio or proportion while maintaining the same relationship between the quantities.

Statistics

Understanding Statistics

Children need to know that…

- *To compare has two different meanings:*
  - *to say how something is like or unlike something else.*
  - *To describe which is larger and which is smaller (and by how many) (Year 2 Autumn 1)*
- *Data is the word used to describe information. This information could include facts, observations, numbers or measurements. (Year 2)*
- *Data can be presented in different types of charts and diagrams to make it easy to understand. (Year 2)*
- *To categorise is to group things that share some commonality. (Year 2)*
- *Categorical data is when you count the number of data points in a non-numeric category (e.g. the number of children with blue, green and brown eyes). (Year 2)*
- *Statistics is the collection, analysis, interpretation, presentation, and organisation of data.*
- *Scaling is when you are given information about something and then have to apply it to a smaller or larger quantity by multiplying or dividing. In graphs, this can be used to help us show data where larger numbers are involved. (Year 3)*
- *When drawing graphs and charts, (Year 3)*
  - *intervals on scales must be evenly spaced.*
  - *Axes must be drawn with a ruler and meet at a right angle.*
  - *Charts must have a clear title which describes what they show.*
  - *Axes must be clearly labelled (with units if appropriate)*
- *Discrete variables are variables that can only have a set of specific values (with no in-between values) – things that can be counted. For example the number of cars in a car park is an example of discrete data. (Year 4)*
- *Continuous variables can be any value within a range. Most measurements are continuous variables. For example, height, weight, temperature and length are all examples of continuous data.(Year 4)*
- *An outlier is a piece of data which doesn't seem to fit the pattern observed. This can be a measurement mistake. If you choose to discount an outlier, you need to have a clear reason for why and report this. (Year 5)*

Charts previously learned:

Children need to know that…

Pictograms (Year 2)
Bar charts (Year 3)
Comparative Graphs (Year 5)
Tally charts (Year 2)
Tables (Year 3)
Timetables (Year 5)
Time graphs (Year 4)
Line Graphs (Year 5)

Pie Charts

Children need to know that…

- A pie chart is a type of graph, representing data in a circle.
- Each segment of the circle represents a fraction of the whole, usually expressed as a percentage.

Mathematical comparisons of data

Children need to know that…

- The average is the middle value of a set of numbers. There are a range of different types of average we can use
  - **Mean:** This is the most common form of average reported. This is calculated by adding all of the individual data points together and dividing the sum by the number of data points in total.
  - **Median:** This is the middle value in the data set, when all data points are arranged from smallest to largest.
  - **Mode:** This is the most common values within the data set.
- The range is the difference between the maximum and minimum values in a data set. A large range indicates that there is significant variation in data. A small range means data points were quite close.

Children need to know how…

- *To ask and answer simple questions about data. (all previous)*
- *To interpret data shown in different ways (all previous)*
- *To compare with data presented in different ways (all previous)*
- *To use and interpret a key using knowledge of multiplication and division. (all previous)*
- *To solve one-step and two-step problems using information presented different ways (all previous)*
- *To present discrete and continuous data using appropriate graphs (all previous)*
- *To solve comparison, sum and difference problems using information presented in the wide range of charts taught so far. (Year 5)*
- *To complete, read and interpret information in tables, including timetables. (Year 5)*
- To interpret and construct pie charts and use these to solve problems.
- To calculate and interpret the mean as an average.
- To select an appropriate average to use.
- To calculate and interpret the range.

Children need to know when…

- *to use appropriate data collection techniques like surveys, tallies, or observations based on the data required. (Year 3)*
- *you have collected enough data to draw conclusions and compare data. (Year 3)*
- *there is a pattern or trend in the data, there is a conclusion to be drawn. (Year 3)*
- *to compare sets of data categorical data, to look for key differences.*
- *To compare sets of continuous data, especially for data which changes over time, to look for patterns and trends.*
- *An approach to collecting data may be most appropriate, thinking about sample size, survey questions and data collection methods.*
- *When designing a survey to collect data, children need to plan their approach by considering factors such as sample size, survey questions, and data collection methods.*
- *An apparent error found when analysing data/calculating with data may mean they need to think critically on their approach and make changes to their strategy.*
- *To use a specific type of chart to present data. (Year 5)*
- To report a specific type of average.
- To report and interpret the range of a dataset.
- To use knowledge of angles to support construction and interpretation of pie charts.
- Keys/legends are important to interpret graphs.
- To interpret graphs seen in real life contexts.

Children need to know why…

- ***There are lots of different styles of chart.*** *Different charts represent different types of data better. For example, categorical data is represented well by the charts we have learned in year 2 and 3 because these charts help us to 'count' the numbers in each category. (Year 2)*
- ***We need to use charts to represent data.*** *Data can be very complicated. Charts make it easier for people to look out the data and understand what it is teaching us. (Year 2)*
- ***We use different types of chart to collect and present data.*** *Some charts are good for recording data quickly (tally chart) – these are useful for data collection; others are helpful for people to look at and make inferences about the data but take longer to construct (bar charts, scaled pictograms) – these are useful for data presentation. (Year 3)*
- ***Although block diagrams and bar charts look the same, we generally use a bar chart.*** *They show the same class of information in the same way. Block diagrams restrict the quantities that you can show without using scaling. (Year 3)*
- **There are different types of average.** The different types of average tell you different things about the 'mid-point' of the data set. Mean looks for the mathematical 'middle', median looks to ignore outliers and find the sequential middle and mode looks for the most common responses.
- **Range is a useful calculation.** Knowing the degree of variance in the data can support you in knowing how reliable any conclusions drawn may be.

Vocabulary	**DATA**	Information.	**CHART/DIAGRAM**	A visual way of presenting data to make it easier to understand.	**QUESTION**	A type of sentence which requires an answer. It usually starts with a question word and ends with a ?
	CATEGORICAL DATA	Data which counts the number of things (e.g. people) in each category.	**CONTINUOUS DATA**	can be any value within a range. Most measurements are continuous variables. For example, height, weight, temperature and length are all examples of continuous data.	**DISCRETE DATA**	can only have a set of specific values (with no in-between values) – things that can be counted. For example the number of cars in a car park is an example of discrete data.
	KEY	A small picture to the side of a chart which tells the reader how to interpret the chart. For example, it may tell you how many data points a picture in a pictogram is worth.	**TALLY MARK**	The small lines used in a tally chart to record individual data points.	**CATEGORY**	Group
	ORIGIN	The point where the X and Y axis meet at a right angle.	**X AXIS**	The horizontal axis. On a bar chart, the X axis records the categories.	**Y AXIS**	The vertical axis. On a bar chart, the X axis records the frequency.
	SCALE	The 'number line' which runs along the axis/axes.	**OUTLIER**	A data point which is significantly different to the pattern in the rest of the data, which may be a result of measurement error.	**AVERAGE**	A mathematical mid-point
	MEDIAN	A form of average, calculated by ordering the datapoints in ascending order and then finding the positional midpoint.	**MODE**	A form of average calculated by finding the most commonly recurrent data point.	**MEAN**	A form of average calculated by adding up all the data points and dividing by the total number of data points.
	RANGE	A way of describing variance within a data set.	**VARIANCE**	A way of describing how spread out data points in a set are. High variance suggests that individual data points are very different. This may mean that the reliability of the data set may need to be considered.		
Revision	To be determined by teachers based on AfL over the course of the year and close analysis of children's data from informal summative assessments.					
Enrichment & wider development						

Year 6 - Summer 2

To be completed in Spring 2 of each year, depending on the needs of the cohort and the transition projects being offered by local secondary schools.

Revisited knowledge
New knowledge

Domain	Declarative knowledge (substantive knowledge)	Procedural knowledge (disciplinary knowledge)	Conditional knowledge (knowing the when and the why)
Vocabulary			
Vocabulary			
Vocabulary			
Enrichment & wider development			