Primary Mathematics Scheme of Work: Stage 3

Unit	*Lessons*	*Key 'Build a Mathematician' (BAM) Indicators*	*Essential knowledge*
Numbers and the number system	8	• Read and write numbers up to 1000 in numerals and in words • Compare and order whole numbers up to 1000 • Count from zero in multiples of 4, 8, 50 and 100 • Add and subtract numbers mentally including a three-digit number and ones, tens and hundreds • Use columnar addition and subtraction with numbers up to three digits • Use known facts to multiply and divide mentally within the 2, 3, 4, 8 and 10 multiplication tables • Multiply a two-digit number by a one-digit number • Understand fractions as proportions • Understand fractions as numbers • Count forward and backwards in tenths • Tell the time using analogue and digital 12-hour clocks • Measure length (mm, cm, m), mass (g, kg) and capacity (ml, l) • Measure perimeters of shapes Stage 3 BAM Progress Tracker Sheet	• Know the place value headings of tenths, ones, tens and hundreds • Know multiplication facts for the 3, 4 and 8 multiplication tables • Know division facts related to the 3, 4 and 8 multiplication tables • Know that a right angle is ¼ of a turn • Know the number of days in each month • Know the number days in a year and a leap year • Know that 60 seconds = 1 minute • Know the Roman numerals from I to XII • Know the vocabulary of time including o'clock, a.m., p.m., morning afternoon, noon and midnight • Know the meaning of 'perimeter'
Counting and comparing	12		
Visualising and constructing	8		
Calculating: addition and subtraction	12		
Calculating: multiplication and division	12		
Exploring time	12		
Exploring fractions	12		
Measuring space	12		
Investigating angles	8		
Calculating fractions and decimals	8		
Exploring money	8		
Presentation of data	8		
Preventing the gap / Going deeper	20		
Total:	140		

Maths Calendar

Based on 4 maths lessons per week, with at least 35 'quality teaching' weeks per year

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
Numbers and the number system 3M1 BAM		Counting and comparing 3M2 BAM, 3M3 BAM			Visualising and constructing		Calculating: addition and subtraction 3M4 BAM, 3M5 BAM			Calculating: multiplication and division 3M6 BAM, 3M7 BAM		
Week 14	**Week 15**	**Week 16**	**Week 17**	**Week 18**	**Week 19**	**Week 20**	**Week 21**	**Week 22**	**Week 23**	**Week 24**	**Week 25**	**Week 26**
Assessment and enrichment		Exploring time 3M11 BAM			Exploring fractions 3M8 BAM, 3M9 BAM			Measuring space 3M12 BAM, 3M13 BAM			Preventing the gap / Going deeper	
Week 27	**Week 28**	**Week 29**	**Week 30**	**Week 31**	**Week 32**	**Week 33**	**Week 34**	**Week 35**	**Week 36**	**Week 37**	**Week 38**	**Week 39**
Assess / enrich	Investigating angles		Calculating fractions & decimals 3M10 BAM		Exploring money		Presentation of data		Assess / enrich	Preventing the gap / Going deeper		

Numbers and the number system — *8 lessons*

Key concepts (National Curriculum statements)

The Big Picture: Number and Place Value progression map

- recognise the place value of each digit in a three-digit number (hundreds, tens, ones)
- read and write numbers up to 1000 in numerals and in words
- identify, represent and estimate numbers using different representations
- solve number problems and practical problems involving these ideas

Return to overview

Possible themes

- Work with numbers up to 1000
- Explore ways of representing numbers
- Develop skills of estimation
- Solve problems involving numbers and the number system

Bring on the Maths⁺: Lower Key Stage 2
Number and Place Value: Place value I, Place value headings, Reading and writing numbers

Possible key learning points

- Understand place value in numbers up to 1000
- Write numbers up to 1000
- Read numbers up to 1000
- Use zero as a place holder in numbers up to 1000
- Interpret numbers up to 1000 on a number line
- Represent numbers up to 1000 using a number line
- Interpret and use scales representing measurements with numbers up to 1000
- Use scales to represent measurements with numbers up to 1000

Prerequisites

- Understand place value in numbers up to two digits
- Read and write numbers up to 100
- Use zero as a place holder in two-digit numbers
- Use and interpret a number line to represent numbers

Mathematical language

Place value
Digit
Hundreds
Tens
Ones
Estimate
Number line
Scale

Pedagogical notes

Pupils should be given opportunity to explain reasoning both verbally and in writing

NCETM: Glossary

Useful resources: Dienes apparatus, place value cards, digit cards, number lines, bead strings, unifix or multi link cubes, cuisenaire rods, Numicon, 100 square

Common approaches
Every classroom displays a number line up to 1000
Every classroom has a place value chart on the wall

Reasoning opportunities and probing questions

- Show me a three-digit number with a tens unit of ‘6’. And another. And another …
- Benny writes the number three hundred and six as ‘3006’. Do you agree with Benny?
- Using a number line, show me the number 243, 567, 909, etc.

NCETM: Place Value Reasoning

Suggested activities

NRICH: Which scripts?
NRICH: Which is quicker?

Learning review
KM: 3M1 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may write three-digit numbers literally, for example, four hundred and six as ‘4006’
- Some pupils may ignore place value and simply write the digits mentioned in a number, for example, four hundred and six as ‘46’

Counting and comparing — 12 lessons

Key concepts (National Curriculum statements)

The Big Picture: Number and Place Value progression map

- compare and order numbers up to 1000
- count from 0 in multiples of 4, 8, 50 and 100; find 10 or 100 more or less than a given number
- solve number problems and practical problems involving these ideas

Return to overview

Possible themes

- Work with numbers up to 1000
- Explore ways of counting
- Solve problems involving counting and comparing

Bring on the Maths+: Lower Key Stage 2
Number and Place Value: Ordering numbers, Counting I, Counting II

Possible key learning points

- Order numbers up to 1000
- Compare numbers up to 1000
- Count (from 0) in multiples of 4
- Count (from 0) in multiples of 8
- Count (from 0) in multiples of 50
- Count (from 0) in multiples of 100
- Find 10 more than a given number
- Find 10 less than a given number
- Find 100 more than a given number
- Find 100 less than a given number

Prerequisites

- Understand place value in numbers up to 1000
- Use <, > and = symbols
- Count in steps of 2, 3 and 5 from 0
- Count in tens from any number, forward and backward

Mathematical language

Place value
Digit
Multiple
More
Less
Positive
Number line

Notation
Use of <, > and = symbols when comparing numbers

Pedagogical notes

Zero is neither positive nor negative.
It is expected that all pupils should count from 0 in multiples of 4, 8, 50 and 100, but they should also be given the opportunity to start with any given number.

NCETM: Glossary

Useful resources: Dienes apparatus, place value cards, digit cards, number lines, bead strings, unifix/multi link cubes, Cuisenaire rods, Numicon, 100 square

Common approaches
Every classroom displays a number line up to 1000
Every classroom has a place value chart on the wall

Reasoning opportunities and probing questions

- Show me the largest three-digit number with a tens unit of '6', hundreds unit '2'. And Another. And another …
- What is the same and what is different: *345, 435, 545, 455* ?
- Convince me that 765 > 567.

NCETM: Place Value Reasoning

Suggested activities

NRICH: The Deca Tree
NCETM: Ordering numbers: Activity A
NCETM: The value of place: Activity E

Learning review
KM: 3M2 BAM Task, 3M3 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may write three-digit numbers literally, for example, four hundred and six as '4006'
- Some pupils may ignore place value and simply write the digits mentioned in a number, for example, four hundred and six as '46'

Visualising and constructing — *8 lessons*

Key concepts (National Curriculum statements)

The Big Picture: Properties of Shape progression map

- identify horizontal and vertical lines and pairs of perpendicular and parallel lines
- draw 2-D shapes and make 3-D shapes using modelling materials; recognise 3-D shapes in different orientations and describe them

Return to overview

Possible themes

- Classify lines
- Construct 2D shapes
- Explore 3D shapes

Possible key learning points

- Identify and draw horizontal and vertical lines
- Identify and draw parallel lines
- Identify and draw perpendicular lines
- Sketch common 2D shapes
- Draw and measure a line in centimetres
- Construct common 2D shapes using a ruler
- Make and identify 3D shapes using modelling materials
- Describe 3D shapes using mathematical language

Prerequisites

- Know the names of common 2D shapes
- Know the names of cuboids, prisms, spheres, pyramids and cones
- Know the meaning of side, edge, vertex (vertices) and face
- Use a straight edge to construct lines and shapes

Mathematical language

Horizontal
Vertical
Perpendicular
Parallel
Face, Edge, Vertex (Vertices)
Cube, Cuboid, Prism, Cylinder, Pyramid, Cone, Sphere
Quadrilateral
Square, Rectangle, Parallelogram, (Isosceles) Trapezium, Kite, Rhombus
Triangle, Circle
Polygon, Hexagon, Pentagon, Octagon, Decagon

Notation
Arrow notation to represent parallel lines
Right angle notation for perpendicular lines

Pedagogical notes

Pupils should be able to draw and measure a line in centimetres when the dimensions are whole numbers.
Suitable modeling materials include Polydron, Geomag, pipe cleaners and even (uncooked!) spaghetti and marshmallows for a bit of messy fun!

NCETM: Glossary

Common approaches
Every classroom has a set of 3D shape posters and quadrilateral posters on the wall

Reasoning opportunities and probing questions

- Show me a pair of parallel lines, perpendicular lines, a vertical line, a horizontal line. And Another …
- Always/Sometimes/Never: Perpendicular lines are horizontal and vertical.
- Convince me that parallel lines can be curved.
- Convince me that a square is a rectangle.

NCETM: Geometry - Properties of Shapes Reasoning

Suggested activities

NCETM: The Art of Mathematics: Activity D
NCETM: Making shapes and solids: Activity A

Learning review
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Pupils may believe, incorrectly, that:
  - perpendicular lines have to be horizontal / vertical
  - only straight lines can be parallel
- Some pupils may think that a square and rectangle are two different shapes.
- Pupils may believe, incorrectly, that all 3-D shapes are prisms

Calculating: addition and subtraction — 12 lessons

Key concepts (National Curriculum statements)

The Big Picture: Calculation progression map

- add and subtract numbers mentally, including: a three-digit number and ones; a three-digit number and tens; a three-digit number and hundreds
- add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction
- estimate the answer to a calculation and use inverse operations to check answers
- solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction

Return to overview

Possible themes

- Extend mental methods of addition and subtraction
- Develop written methods of addition and subtraction
- Estimate answers to calculations
- Solve problems involving addition and subtraction

Bring on the Maths⁺: Lower Key Stage 2
Calculating: Addition and subtraction using mental methods, Addition and subtraction using written methods I

Possible key learning points

- Add three-digit numbers and ones or tens mentally
- Add three-digit numbers and hundreds mentally
- Subtract three-digit numbers and one or tens mentally
- Subtract three-digit numbers and hundreds mentally
- Use column addition for numbers with up to three digits when carrying is not required
- Use column addition for three-digit and two-digit numbers when carrying is required
- Use column addition for numbers with three-digits when carrying is required
- Use column subtraction for numbers with up to three digits when exchanging is not required
- Use column subtraction for three-digit and two-digit numbers when exchanging is required
- Use column subtraction for numbers with up to three-digits when exchanging is required
- Estimate the answer to a calculation
- Identify when addition or subtraction is needed as part of solving a problem

Prerequisites

- Know that addition and subtraction are inverse operations
- Recall addition and subtraction facts to 20
- Derive addition and subtraction facts to 100
- Add and subtract two-digit numbers and ones (or tens) mentally

Mathematical language

Calculation
Calculate
Addition
Subtraction
Sum, Total
Difference, Minus, Less
Column addition
Column subtraction
Exchange
Operation
Estimate
Inverse
Operation

Pedagogical notes

Interpret 'mentally' as 'can you do the calculation in your head or with jottings?'. The Kangaroo Maths Interactive Target Boards are very powerful in supporting this important message. Ensure that pupils can deal with column subtractions that include a 0 within the first number; e.g. 8027 – 437
KM: Progression: Addition and Subtraction and Calculation overview
NCETM: The Bar Model, Subtraction, Glossary
Useful resources: Digit cards, number lines, bead strings, place-value cards, base 10, 100 squares, place-value counters

Common approaches
All teachers use 'sum' to refer only to the result of an addition. Teachers must say 'complete these calculations' instead of 'complete these sums'. All pupils use books / paper with 1cm squares and ensure that each digit is written in one square. When carrying, those numbers being carried are placed beneath the answer line. During column subtraction the language of 'exchanging' is used instead of 'borrowing'. When exchanging, those numbers being altered or moved are written above the calculation

Reasoning opportunities and probing questions

- Provide examples of column addition and subtraction with missing digits. Challenge pupils to find these digits and explain their reasoning.
- Show me an example of a column addition (that does not includes carrying) with the answer 576. And Another …
- Show me an example of a column addition (that includes carrying) with the answer 512. And Another …
- Convince me that 428 – 136 = 292

NCETM: Addition and Subtraction Reasoning

Suggested activities

KM: Interactive target boards
KM: Maths to Infinity: Addition and subtraction foundations
NRICH: Reach 100, Twenty Divided Into Six, Consecutive Numbers
NCETM: Triangular cards: Activity E
NCETM: Interactive Base 10 Blocks: Activity F, G and H
NCETM: Estimating differences: Activity F

Learning review
KM: 3M4 BAM Task, 3M5 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may carry the wrong carry digit (i.e. the ones digit rather than the tens digit)
- Some pupils incorrectly assume and use commutativity within column subtraction; for example:

$$\begin{array}{r} 9\ 2\ 6 \\ -\ 7\ 3\ 4 \\ \hline 2\ \color{red}{1}\ 2 \\ \hline \end{array}$$

- Some pupils may not use place value settings correctly (especially when the numbers have a different number of digits)

Calculating: multiplication and division — 12 lessons

Key concepts (National Curriculum statements)

The Big Picture: Calculation progression map

- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables
- write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods
- solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems in which n objects are connected to m objects

Return to overview

Possible themes

- Develop mental arithmetic skills
- Develop knowledge of multiplication tables
- Explore ways of writing calculations
- Solve problems involving multiplication and division

Bring on the Maths⁺: Lower Key Stage 2
Times tables: The three times table, The four times table, The eight times table

Possible key learning points

- Recall and use multiplication facts for the 3 times table
- Recall and use multiplication facts for the 4 times table
- Recall and use multiplication facts for the 8 times table
- Recall and use division facts for the 3 times table
- Recall and use division facts for the 4 times table
- Recall and use division facts for the 8 times table
- Understand the distributive law applied to a multiplication of a two-digit number by a one-digit number
- Identify the correct operation(s) required in order to solve a problem and create mathematical statements
- Use known and derived facts when multiplying and dividing mentally
- Use efficient methods to multiply a two-digit number by a one-digit number
- Identify when a scaling (or correspondence problem) can be solved using multiplication or division

Prerequisites

- Recall multiplication and division facts for 2, 5 and 10 multiplication tables
- Understand that multiplication and division are inverse operations
- Understand that multiplication is commutative

Mathematical language

Calculation
Calculate
Mental arithmetic
Multiplication table, Times table
Multiply, Multiplication
Times
Product
Commutative
Divide, Division
Inverse
Operation
Estimate

Pedagogical notes

Pupils make the connection between arrays, multiplying using the distributive law and the compact grid method. The transition from arrays to a compact grid method aids conceptual understanding of short and long multiplication. It also supports the multiplication of algebraic expressions at a later stage.
KM: Progression: Multiplication and Division and Calculation overview
NCETM: The Bar Model, Multiplication and division
NCETM: Multiplicative reasoning
NCETM: Glossary
Useful resources: Counters, Hundred squares, Times table squares, Counting stick, Cuisenaire rods, Place value discs

Common approaches
Knowing the times tables is understood as knowing multiplication facts, knowing division facts and related facts.
All classrooms display a times table poster with a twist
Connecting the compact grid method with arrays is essential

Reasoning opportunities and probing questions

- Show me a multiplication (division) fact from the 3 multiplication table, 4 multiplication table, 8 multiplication table. And Another …
- Ask pupils to complete the statement: '*If I know 7* × 4 = 28, then …'
- Show me a problem that can be solved using multiplication, division. And Another …
- Convince me that 40 × 8 = 320
- Convince me that 43 × 8 = 344

NCETM: Multiplication and Division Reasoning

Suggested activities

KM: Interactive target boards
KM: Maths to Infinity: Multiplication and division foundations
KM: Times Tables resources
NRICH: Andy's Marbles
NCETM: Always, Sometimes, Never: Activity A
NCETM: Pendulum Counting: Activity B
NCETM: Multiplying Numbers: Activity D

Learning review
KM: 3M6 BAM Task, 3M7 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils 'see' the times tables as a list of 12 unconnected facts
- Some pupils do not understand multiplication is commutative.
- Some pupils may write statements such as 2 ÷ 8 = 4
- Some pupils think because 3 × 5 = 5 × 3 then 15 ÷ 3 = 3 ÷ 15

Exploring time — 12 lessons

Key concepts (National Curriculum statements)

The Big Picture: Measurement and mensuration progression map

- tell and write the time from an analogue clock, including using Roman numerals from I to XII, and 12-hour and 24-hour clocks
- estimate and read time with increasing accuracy to the nearest minute; record and compare time in terms of seconds, minutes and hours; use vocabulary such as o'clock, a.m./p.m., morning, afternoon, noon and midnight
- know the number of seconds in a minute and the number of days in each month, year and leap year
- compare durations of events [for example to calculate the time taken by particular events or tasks]

Return to overview

Possible themes

- Understand and use Roman numerals
- Tell the time
- Estimate time
- Solve problems involving time

Bring on the Maths⁺: Lower Key Stage 2
Measures: Months of the year, Telling the time

Possible key learning points

- Read Roman numerals up to XII
- Know the vocabulary of telling the time
- Know the number of seconds in a minute
- Know the number of days in each month, year and leap year
- Tell the time from a 12-hour analogue clock to the nearest minute
- Tell the time from a 24-hour analogue clock to the nearest minute
- Tell the time from a clock using Roman numerals to the nearest minute
- Write times using 12-hour format
- Estimate times
- Compare times given in seconds, minutes and/or hours
- Calculate the time taken by particular events or tasks

Prerequisites

- Know the number of minutes in an hour, hours in a day, and days in a week
- Tell and write the time to the nearest five minutes

Mathematical language

Analogue
12-hour
24-hour
o'clock
Morning
Afternoon
Noon, Midnight
Second, Minute, Hour
Day, Week, Month
Year
Leap year
Roman Numeral

Notation
The Roman numeral for 4 is IV. It is the only exception to the rules of Roman numerals as it is sometimes written IIII on a clock or watch
Using a.m. and p.m. for 12-hour clock notation

Pedagogical notes

In general it is incorrect to repeat a Roman numeral symbol four times (i.e. XXXX). Also, the subtractive method should only be used (1) if subtracting powers of ten (i.e. I, X or C), and (2) if subtracting from the next two higher symbols (for example, I can be subtracted from V or X, but not L, C, D or M). Therefore 49 cannot be written as XXXXIX, or as IL, and must be written as XLIX. See NCETM: Roman numerals
24 clock notation using four digits. Any time before 10:00 a.m. uses a zero as the second hour digit, for example 9:15 a.m. is written as '09:15'.
Noon is 12:00 and midnight is 00:00
NCETM: Glossary

Common approaches
Explain the origins of the Roman numerals I, V and X are possibly linked to the human body being used to communicate numbers across the marketplace (I – finger, V – shape of the hand with fingers closed together and X – arms crossed)
Use of a colon to write 12- and 24- hour times
Using a.m. and p.m. for 12-hour clock notation
Noon is treated as 12:00 and midnight as 00:00

Reasoning opportunities and probing questions

- Can a 24-hour clock be analogue? For example, try and tell the time using images of the Greenwich Observatory Clock.
- What is the same and what is different: *VII, 7, I, IV* ?
- Always, sometimes, never: Only one month has 28 days.

NCETM: Measurement Reasoning

Suggested activities

NRICH: Two Clocks
NCETM: Virtual Clock: Activity D

Learning review
KM: 3M11 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- The use of IIII on a clock face suggests that a Roman numeral can be repeated four times, but this is a special case. In general, three is the maximum number of repeats and the subtractive method should be used instead (i.e. IV)
- Some pupils may think that all months have the same number of days.
- Some pupils do not have a realistic sense of the length of one minute (usually they count one, two, three … etc. far too quickly!)

Exploring fractions — 12 lessons

Key concepts (National Curriculum statements)

The Big Picture: Fractions, decimals and percentages progression map

- recognise, find and write fractions of a discrete set of objects: unit fractions and non-unit fractions with small denominators
- recognise and use fractions as numbers: unit fractions and non-unit fractions with small denominators
- recognise and show, using diagrams, equivalent fractions with small denominators
- compare and order unit fractions, and fractions with the same denominators

Return to overview

Possible themes

- Understand the meaning of a fraction
- Investigate the equivalence of fractions
- Compare fractions

Bring on the Maths⁺: Lower Key Stage 2
Fractions & decimals: Fractions as numbers

Possible key learning points

- Recognise a unit fraction of a set of objects
- Recognise a non-unit fraction of a set of objects
- Write a fraction of a set of objects
- Understand a unit fraction as a number
- Understand a non-unit fraction as a number
- Understand the concept of equivalent fractions
- Recognise equivalent fractions from diagrams
- Complete diagrams to show equivalent fractions
- Create diagrams to show equivalent fractions
- Compare a set of unit fractions
- Compare a set of fractions which have the same denominator

Prerequisites

- Recognise, find, name and write the fractions $^1/_3$, $^1/_4$, $^2/_4$ and $^3/_4$ of a length, shape, set of objects or quantity
- Write simple fraction statements; e.g. $^1/_2$ of 6 = 3
- Recognise the equivalence of $^2/_4$ and $^1/_2$

Mathematical language

Fraction
Unit fraction
Non-unit fraction
Numerator
Denominator
Equivalent (fraction)
Compare
Greater than, less than

Notation
Horizontal bar for fractions
Diagonal bar for fractions
Use of <, > and = symbols when comparing fractions

Pedagogical notes

Describe $^1/_3$ as 'there are three equal parts and I take one', and $^3/_4$ as 'there are four equal parts and I take three'. Also make the connection between $^3/_4$ and ' 3 of $^1/_4$ '
Be alert to pupils reinforcing misconceptions through language such as 'the bigger half'.
To explore the equivalency of fractions make several copies of a diagram with half shaded. Show that splitting these diagrams with varying numbers of lines does not alter the fraction of the shape that is shaded.
NCETM: Teaching fractions
NCETM: The Bar Model
NCETM: Glossary

Common approaches
In this unit, pupils work with denominators of at least 2 to 10.
Pupils are expected to use horizontal bar notation for fractions.

Reasoning opportunities and probing questions

- Show me a fraction. And another. And another.
- Which you would prefer, ½ of a cake, $^1/_3$ of a cake or ¼ of a cake?
- Convince me that $\frac{1}{2} = \frac{2}{4}$
- Show me a picture of $\frac{1}{5}$. And another. And another.

NCETM: Fractions Reasoning

Suggested activities

NRICH: Fraction Match
NRICH: Matching Fractions
NCETM: Activity F - Comparing Fractions

Learning review
KM: 3M8 BAM Task, 3M9 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may think that diagrams to show fractions must always be circular
- Some pupils may not acknowledge that the parts in a fraction must be equal; e.g. they talk about the 'bigger half'.
- Some pupils may not appreciate the fact that a non-unit fraction is a multiple of a unit fraction

Measuring space

12 lessons

Key concepts (National Curriculum statements)

- measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml)
- measure the perimeter of simple 2-D shapes

The Big Picture: Measurement and mensuration progression map

Return to overview

Possible themes

- Develop measurement skills
- Solve problems involving measurement
- Understand perimeter

Possible key learning points

- Use a ruler to measure lengths to the nearest millimetre
- Use a ruler to measure lengths to the nearest centimetre
- Use measuring equipment to measure lengths to the nearest metre
- Use digital and mechanical scales to measure mass to the nearest kg
- Use digital and mechanical scales to measure mass to the nearest g
- Use measuring vessels to measure a volume of liquid
- Choose appropriate units to state the result of a measurement
- Compare the length of two or more objects
- Compare the mass of two or more objects
- Compare the volume of two or more objects
- Compare the capacity of two or more objects
- Find the perimeter of a 2-D shape by measuring

Prerequisites

- Measure length using m, cm
- Measure mass using kg, g
- Measure volume / capacity using l, ml

Mathematical language

Length, distance
Mass
Volume
Capacity
Metre, centimetre, millimetre
Kilogram, gram
Litre, millilitre
Perimeter
2-D

Notation
Abbreviations of units in the metric system: m, cm, mm, kg, g, l, ml

Pedagogical notes

In this unit pupils should only measure perimeter; e.g. with string. Calculating perimeter is in Stage 4.
Weight and mass are distinct though they are often confused in everyday language. Weight is the force due to gravity, and is calculated as mass multiplied by the acceleration due to gravity. Therefore weight varies due to location while mass is a constant measurement.
The prefix 'centi-' means one hundredth, and the prefix 'milli-' means one thousandth. These words are of Latin origin.
The prefix 'kilo-' means one thousand. This is Greek in origin.
NCETM: Glossary

Common approaches
Every classroom has a sack of sand (25 kg), a bag of sugar (1 kg), a cheque book (1 cheque is 1 gram), a bottle of water (1 litre, and also 1 kg of water) and a teaspoon (5 ml)
Teachers ensure that pupils correctly position the '0' on the ruler when measuring the line.

Reasoning opportunities and probing questions

- Show me something in the classroom that is between 20 cm and 40 cm. And another. And another.
- Kenny measures two lines; 1 m and 35 cm. He says the difference is 650 mm. Do you agree with Kenny? Explain your answer.
- Convince me how to find the perimeter of a shape.
- Create a shape with a perimeter greater than 30 cm.

NCETM: Measurement Reasoning

Suggested activities

NRICH: Olympic Starters
NRICH: Car Journey
NCETM: Activity B - Perimeter
NCETM: Activity A - Measures

Learning review
KM: 3M12 BAM Task, 3M13 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may think that you put the end of the ruler (rather than the '0') at the start of a line to measure it.
- Some pupils may think that the conversion factor between all measures is multiply or divide by 10.
- Some pupils may think that milli- refers to 'million'

Investigating angles — *8 lessons*

Key concepts (National Curriculum statements)

The Big Picture: Position and direction progression map

- recognise angles as a property of shape or a description of a turn
- identify right angles, recognise that two right angles make a half-turn, three make three quarters of a turn and four a complete turn; identify whether angles are greater than or less than a right angle

Return to overview

Possible themes

- Explore angles and turning
- Compare angles

Bring on the Maths⁺: Lower Key Stage 2
Properties of Shapes: Turnings

Possible key learning points

- Understand that angle is a description of turn
- Understand that angles are a feature of shapes
- Identify a right angle as a quarter turn and when a shape has a right angle
- Recognise that two right angles make a half-turn
- Recognise that three right angles make three quarters of a turn
- Recognise that four right angles make a complete turn
- Identify angles that are less than right angle
- Identify angles that are greater than a right angle

Prerequisites

- Recognise and name the fractions $^1/_2$, $^1/_4$, $^2/_4$, $^3/_4$

Mathematical language

Half
Quarter
Three quarters
Angle
Turn
Right angle
Greater than, less than

Notation
Right angle notation

Pedagogical notes

Understanding degrees as a way of measuring angles is not introduced until Stage 5.
It is thought that the origin of the name 'right angle' is the Latin word for 'upright'; as in perpendicular to the horizontal base in architectural contexts.
NCETM: Glossary

Common approaches
All pupils experience the 'feel' of a right angle by turning through quarter turns

Reasoning opportunities and probing questions

- Show me a right angle in this classroom. And another. And another.
- Show me an angle in this classroom less (greater) than a right angle. And another. And another.
- Is this a right angle? Explain your answer.

- Convince me why this is not called a 'left' angle!

NCETM: Geometry - Properties of Shapes Reasoning

Suggested activities

NRICH: Square It
NCETM: Activity Set B
NCETM: Activity Set C

Learning review
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may think that right angles have to look like this:

- Some pupils may think that right angles have to be created from a horizontal and vertical line
- Some pupils may think that all turns have to be in a clockwise direction

Calculating fractions and decimals

8 lessons

Key concepts (National Curriculum statements)

The Big Picture: Fractions, decimals and percentages progression map

- count up and down in tenths; recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers or quantities by 10
- add and subtract fractions with the same denominator within one whole [for example, $^5/_7 + ^1/_7 = ^6/_7$]

Return to overview

Possible themes

- Develop knowledge of place value
- Explore decimals
- Calculate with fractions

Bring on the Maths⁺: Lower Key Stage 2
Fractions & decimals: Counting in tenths

Possible key learning points

- Recognise that tenths arise from dividing a number or object into ten equal parts
- Write tenths as a fraction and as a decimal
- Count up in tenths
- Count down in tenths
- Add fractions with the same denominator within one whole
- Subtract fractions with the same denominator within one whole

Prerequisites

- Understand place value in numbers up to 1000
- Connect the ten times table to place value
- Recognise and write unit and non-unit fractions
- Understand unit and non-unit fractions as numbers on a number line

Mathematical language

Place value
Tenth
Decimal
Divide
Fraction
Unit fraction
Non-unit fraction
Numerator
Denominator
Add
Subtract

Notation
Decimal point
t notation for tenths
Horizontal bar for fractions
Diagonal bar for fractions

Pedagogical notes

Pupils will need to know the place value headings of tenths.
Some countries use a comma for a decimal point.
It is important to start at different numbers when counting up and down in tenths.
Counting should be practised as part of everyday practice: choral counting should not be restricted to this unit.
Pictorial representations of calculations involving the addition and subtraction facts are essential for pupils to understand why only the numerators are added or subtracted, not the denominators (e.g. '1 of 5 equal parts' add ' 2 of 5 equal parts' equals '3 of 5 equal parts')
NCETM: Teaching fractions
NCETM: Fractions videos
NCETM: Glossary

Common approaches
Pupils are expected to use horizontal bar notation for fractions
Teachers and pupils adopt the mantra: 'We say one fifth we think one of five equal parts; we say two fifths, we think two of five equal parts, etc'

Reasoning opportunities and probing questions

- Show me a decimal and fraction equivalent pair. And another. And another.
- Jenny is counting in tenths '…. 2.7, 2.8, 2.9, 2.10, 2.11 …'. Do you agree with Jenny? Explain your answer.
- Convince me that 6 ÷ 10 = 0.6
- Show me two fractions that add together to make a whole. And another pair. And another pair.
- Kenny thinks that $\frac{1}{4} + \frac{1}{4} = \frac{2}{8}$. Do you agree with Kenny? Explain your answer.
- Convince me how to subtract fractions.

NCETM: Fractions Reasoning

Suggested activities

NCETM: Activity A – visualising fractions along a line
NCETM: Activity E – adding fractions

Learning review
KM: 3M10 BAM Task
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may think that the first place value heading after the decimal point is 'one-ths' or 'unit-ths'
- Some pupils may think that you simply add the numerators and add the denominators when adding fractions.
- Some pupils may think that you simply subtract the numerators and subtract the denominators when subtracting fractions.
- Some pupils may move from 2.9 to 2.10 when counting in tenths
- Some pupils may read the number 2.10 as 'two point ten'

Exploring money — *8 lessons*

Key concepts (National Curriculum statements)

- add and subtract amounts of money to give change, using both £ and p in practical contexts

The Big Picture: Calculation progression map

Return to overview

Possible themes

- Explore money
- Solve problems involving money

Possible key learning points

- Recognise the value of coins
- Add amounts of money when the units are the same
- Add amounts of money when the units are different
- Subtract amounts of money when the units are the same
- Subtract amounts of money when the units are different
- Record a practical money problem using £ and/or p notation
- Solve practical problems that involve calculating change in manageable amounts

Prerequisites

- Recognise the coins: 1p, 2p, 5p, 10p, 20p, 50p, £1 and £2
- Read and say amounts of money using the coins 1p, 2p, 5p, 10p, 20p, 50p, £1 and £2
- Count, say and record amounts of money using the coins 1p, 2p, 5p, 10p, 20p, 50p, £1 and £2
- Recognise the notes: £5 and £10
- Recognise the symbols for pounds (£) and pence (p)
- Record amounts of money using either pounds (£) or pence (p)
- Find different combinations of coins that equal the same amounts of money
- Solve simple problems involving money, including giving change

Mathematical language

Money
Coin
Change
Note

Notation
Pounds (£)
Pence (p)

Pedagogical notes

This unit focuses on pupils solving money problems in practical situations involving either pounds or pence. They are expected to be able to record the solution using £ or p notation.
Note: Decimal notation for money is not introduced formally until Stage 4.

NCETM: Glossary

Common approaches
£ **and** p are not used together to record an amount of money, for example £3.27 or 327p but not £3.27p

Reasoning opportunities and probing questions

- Kenny thinks that 'the larger the size of the coin, the greater the value of the coin'. Do you agree with Kenny?
- What is the same and what is different: *2p coin, 5p coin, 10p coin, 20p coin?*
- Jenny buys four items and pays with a £5 note. She gets three £1 coins and three 10p coins in her change. Convince me she could have paid for the four items using exactly five coins.
- Benny buys four items costing 10p, 50p, 10p and 5p. He pays with a £1 coin. He only expects to get one coin in his change. Do you agree with Benny? Explain your answer

Suggested activities

NRICH: Five Coins
NRICH: Money Bags
NRICH: The Puzzling Sweet Shop
NCETM: Activity C

Learning review
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may think that the larger the size of the coin, the greater the value of the coin, for example, a 2p coin is greater in value than a 5p coin.
- Some pupils may ignore the units in the first instance and simply add the numerical value of the coins, for example, 10p coin + £1 coin = 11p or £11
- Some pupils may try and use the £ and p notation together, such as £3p rather than £3 or 300p.

Presentation of data — 8 lessons

Key concepts (National Curriculum statements)

The Big Picture: Statistics progression map

- interpret and present data using bar charts, pictograms and tables
- solve one-step and two-step questions [for example, 'How many more?' and 'How many fewer?'] using information presented in scaled bar charts and pictograms and tables

Return to overview

Possible themes

- Explore ways to show data
- Solve problems involving charts and tables

Bring on the Maths⁺: Lower Key Stage 2
Statistics: Bar charts and pictograms

Possible key learning points

- Interpret a pictogram where the symbol represents multiple items
- Construct a pictogram where the symbol represents multiple items
- Interpret a bar chart
- Construct a bar chart
- Interpret data in a table
- Create a table to show data
- Answer one-step questions about data in charts and tables (e.g. 'How many?')
- Answer two-step questions about data in charts and tables (e.g. 'How many more?')

Prerequisites

- Interpret and construct block diagrams
- Interpret and construct pictograms where the symbol represents a single item or 2,5 and 10 units.
- Interpret and construct simple tables
- Understand tallying

Mathematical language

Data
Pictogram
Symbol
Key
Tally
Bar chart
Table
Total
Compare
Axis

Notation
When tallying, groups of five are created by striking through each group of four

Pedagogical notes

The bar chart was introduced by William Playfair, a Scottish economist, in 1786
Pupils are expected to understand and use simple scales, such as 2, 5, or 10 units per cm for bar charts and 2, 5, or 10 units per symbol for pictograms.

Note: The word 'data' is introduced in stage 3. It the plural of *datum*, from the Latin '*datum*' meaning "(thing) given,".

NCETM: Glossary

Common approaches
Pupils always construct or identify the key for a pictogram before doing anything else.

Reasoning opportunities and probing questions

- Show me a bar chart. And another. And another.
- Kenny thinks that a bar chart is the same as a block diagram. Do you agree with Kenny? Explain your answer.
- Jenny draws a bar chart with gaps between the bars. Lenny draws a bar chart with no gaps between the bars. Who is correct? Explain your answer.
- Penny draws a bar chart with horizontal bars. Benny says the bars must be vertical. Who is correct? Explain your answer.
- Always/Sometimes/Never: One centimetre on the frequency axis of a bar chart represents one unit.

NCETM: Statistics Reasoning

Suggested activities

KM: Make a 'Human' Bar Chart by asking pupils to stand on a giant set of axes.
KM: Stick on the Maths HD2: Bar charts and pictograms
NRICH: Class 5's Names
NRICH: Our Sports
NRICH: The Olympic Flame: Are You in the 95%?
NCETM: Activity A
NCETM: Activity B

Learning review
NCETM: NC Assessment Materials (Teaching and Assessing Mastery)

Possible misconceptions

- Some pupils may not leave gaps between the bars in a bar chart
- Some pupils may think that one centimetre on the frequency axis of a bar chart always represents one unit in a bar chart.
- Some pupils may think that a symbol always represents one unit in a pictogram.
- Some pupils may think that the bars of a bar chart must be vertical.