Stage Overview

7-11 Pathway		
Minimum expected standard at end of KS1	Exceeding minimum expected standard at end of KS1	
Stage 2	Stage 3	Year 3
Stage 3	Stage 4	Year 4
Stage 4	Stage 5	Year 5
Stage 5	Stage 6	Year 6

11-16 Pathway		
Below expected standard at end of KS2	Expected standard at end of KS2	
Stage 6	Stage 7	Year 7
Stage 7	Stage 8	Year 8
Stage 8	Stage 9	Year 9
Stage 9	Stage 10	Year 10
Stage 10 Lite	Stage 11	Year 11

Secondary Scheme of Work: Stage 7

Unit
Numbers and the number system
Calculating
Checking, approximating and estimating
Counting and comparing
Visualising and constructing
Investigating properties of shapes
Algebraic proficiency: tinkering
Exploring fractions, decimals and percentages
Proportional reasoning
Pattern sniffing
Measuring space
Investigating angles
Calculating fractions, decimals and percentages
Solving equations and inequalities
Calculating space
Mathematical movement
Presentation of data
Measuring data

Unit names chosen based on mathematical habits of mind (Cuoco, 1996). Organised to ensure any instances of prerequisite knowledge within a year are covered in the first term. All stages align closely throughout the year.

Secondary Scheme of Work: Stage 7

Unit
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Calculating
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Calculating space
Mathematical movement
Presentation of data
Measuring data

Key 'Build a Mathematician' (BAM) Indicators
• Use positive integer powers and associated real roots
• Apply the four operations with decimal numbers
• Write a quantity as a fraction or percentage of another
• Use multiplicative reasoning to interpret percentage change
• Add, subtract, multiply and divide with fractions and mixed numbers
• Check calculations using approximation, estimation or inverse operations
• Simplify and manipulate expressions by collecting like terms
• Simplify and manipulate expressions by multiplying a single term over a bracket
• Substitute numbers into formulae
• Solve linear equations in one unknown
• Understand and use lines parallel to the axes, y = x and y = -x
• Calculate surface area of cubes and cuboids
• Understand and use geometric notation for labelling angles, lengths, equal lengths and parallel lines

Stage 7 BAM Progress Tracker Sheet

The first part of a framework for assessing without levels: 13 '**Build a Mathematician (BAM)' indicators** for each year are chosen to represent the minimum expected outcomes by the end of the stage, critical in developing conceptual understanding and essential for pupils to make progress to the next stage

Secondary Scheme of Work: Stage 7

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Measuring data

Key 'Build a Mathematician' (BAM) Indicators	Essential knowledge
• Use positive integer powers and associated real roots • Apply the four operations with decimal numbers • Write a quantity as a fraction or percentage of another • Use multiplicative reasoning to interpret percentage change • Add, subtract, multiply and divide with fractions and mixed numbers • Check calculations using approximation, estimation or inverse operations • Simplify and manipulate expressions by collecting like terms • Simplify and manipulate expressions by multiplying a single term over a bracket • Substitute numbers into formulae • Solve linear equations in one unknown • Understand and use lines parallel to the axes, y = x and y = -x • Calculate surface area of cubes and cuboids • Understand and use geometric notation for labelling angles, lengths, equal lengths and parallel lines	• Know the first 6 cube numbers • Know the first 12 triangular numbers • Know the symbols =, ≠, <, >, ≤, ≥ • Know the order of operations including brackets • Know basic algebraic notation • Know that area of a rectangle = l × w • Know that area of a triangle = b × h ÷ 2 • Know that area of a parallelogram = b × h • Know that area of a trapezium = ((a + b) ÷ 2) × h • Know that volume of a cuboid = l × w × h • Know the meaning of faces, edges and vertices • Know the names of special triangles and quadrilaterals • Know how to work out measures of central tendency • Know how to calculate the range
Stage 7 BAM Pr… …sheet	

Alongside the BAM indicators, **essential knowledge** lists the facts that students need to know in order to make progress in their mathematics

Secondary Scheme of Work: Stage 7

Unit	Lessons	Key 'Build a Mathematician' (BAM) Indicators	Essential knowledge
Numbers and the number system	12	• Use positive integer powers and associated real roots	• Know the first 6 cube numbers
Calculating	16	• Apply the four operations with decimal numbers	• Know the first 12 triangular numbers
Checking, approximating and estimating	3	• Write a quantity as a fraction or percentage of another	• Know the symbols =, ≠, <, >, ≤, ≥
Counting and comparing	9	• Use multiplicative reasoning to interpret percentage change	• Know the order of operations including brackets
Visualising and constructing	4	• Add, subtract, multiply and divide with fractions and mixed numbers	• Know basic algebraic notation
Investigating properties of shapes	5	• Check calculations using approximation, estimation or inverse operations	• Know that area of a rectangle = l × w
Algebraic proficiency: tinkering	8	• Simplify and manipulate expressions by collecting like terms	• Know that area of a triangle = b × h ÷ 2
Exploring fractions, decimals and percentages	4	• Simplify and manipulate expressions by multiplying a single term over a bracket	• Know that area of a parallelogram = b × h
Proportional reasoning	4	• Substitute numbers into formulae	• Know that area of a trapezium = ((a + b) ÷ 2) × h
Pattern sniffing	3	• Solve linear equations in one unknown	• Know that volume of a cuboid = l × w × h
Measuring space	7	• Understand and use lines parallel to the axes, y = x and y = -x	• Know the meaning of faces, edges and vertices
Investigating angles	3	• Calculate surface area of cubes and cuboids	• Know the names of special triangles and quadrilaterals
Calculating fractions, decimals and percentages	15	• Understand and use geometric notation for labelling angles, lengths, equal lengths and parallel lines	• Know how to work out measures of central tendency
Solving equations and inequalities	5		• Know how to calculate the range
Calculating space	5		
Mathematical movement	7		
Presentation of data	6		
Measuring data	7		
Total:	123	Stage 7 BAM Progress Tracker Sheet	

The number of **hours** for a unit based on based on 7 maths lessons per fortnight, with at least 35 'quality teaching' weeks per year. However, the curriculum model in your school, the place of deliberate practice, and the time it takes students to master concepts will all influence the reality.

Secondary Scheme of Work: Stage 7

Unit	Lessons	Key 'Build a Mathematician' (BAM) Indicators	Essential knowledge
Numbers and the number system	12	• Use positive integer powers and associated real roots • Apply the four operations with decimal numbers • Write a quantity as a fraction or percentage of another • Use multiplicative reasoning to interpret percentage change • Add, subtract, multiply and divide with fractions and mixed numbers • Check calculations using approximation, estimation or inverse operations	• Know the first 6 cube numbers • Know the first 12 triangular numbers • Know the symbols =, ≠, <, >, ≤, ≥ • Know the order of operations including brackets • Know basic algebraic notation • Know that area of a rectangle = l × w • Know that area of a triangle = b × h ÷ 2 • Know that area of a parallelogram = b × h • Know that area of a trapezium = ((a + b) ÷ 2) × h • Know that volume of a cuboid = l × w × h • Know the meaning of faces, edges and vertices • Know the names of special triangles and quadrilaterals • Know how to work out measures of central tendency • Know how to calculate the range
Calculating	16		
Checking, approximating and estimating	3		
Counting and comparing	9		
Visualising and constructing	4		
Investigating properties of shapes	5		
Algebraic proficiency: tinkering	8		
Exploring fractions, decimals and percentages	4		
Proportional reasoning	4		
Pattern sniffing	3		
Measuring space	7		
Investigating angles	3		
Calculating fractions, decimals and percentages	1		
Solving equations and inequalities	5		
Calculating space	5		
Mathematical movement	7		
Presentation of data	6		
Measuring data	7		
Total:	12		

Suggested 'Maths Calendar' for the year based on 35 weeks of teaching and 4 weeks for Assessment, Enrichment and Intervention / Preventing the Gap

Maths Calendar

Based on 7 maths lessons per fortnight, 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 7M1 BAM			Calculating 7M2 BAM					Checking 7M6 BAM	Counting and comparing		Visualising etc 7M13 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
Assess and enrich	Properties of shapes		Algebraic proficiency: tinkering 7M7 BAM, 7M8 BAM, 7M9 BAM		Exploring FDP 7M3 BAM	Prop'l reasoning	Patterns	Measuring space		Angles	Calculating FDP	

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
Assessment	Calculating FDP cont'd 7M4 BAM, 7M5 BAM		Solving equations 7M10 BAM		Calculating space 7M12 BAM	Mathematical movement 7M11 BAM		Presentation of data		Measuring data		Assessment

Unit Overview

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
- use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5
- recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions

'**Key concepts**' taken from the DfE National Curriculum Programme of Study (Stages 1 to 6) and DfE GCSE Subject Content and Assessment Objectives (Stages 7 to 11). Statements grouped to create units for the medium term plans. Progression maps built to show the big picture from Years 1 to 11.

To see the connections to previous and future learning, '**progression maps**' for each defined area of mathematics can be found by following these links.

Numbers and the number system	12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
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- recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions

Return to overview

Possible themes	Possible key learning points
• Solve problems using common factors and highest common factors • Exploring prime numbers • Solve problems using common multiples and lowest common multiples • Explore powers and roots	• Find common factors of numbers • Find the highest common factor of numbers, including co-prime • Recognise and solve problems involving highest common factor • Find prime numbers and test numbers to see if they are prime • Find common multiples of numbers • Recognise and solve problems involving the lowest common multiple • Read, write and evaluate powers • Recognise and use triangular, square and cube numbers • Define and find square roots (including using the $\sqrt{\square}$ symbol) • Define and find cube roots (including using the $\sqrt[3]{\square}$ symbol), including the use of a scientific calculator • Define and find other roots (including using the a $\sqrt[\square]{\square}$ symbols), including the use of a scientific calculator • Recognise and use simple arithmetic progressions

Possible themes identified that describe the big ideas to be explored in this unit

See *Embedding Formative Assessment, Wiliam, 2011* and *Visible Learning for Teachers, Hattie, 2011*

Possible **key learning points** identified that describe the process of learning. They are examples of what the teacher might select for their class. These could also be thought of as learning objectives.

Numbers and the number system — *12 lessons*

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
- use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5
- recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions

Return to overview

Possible themes

- Solve problems using common factors and highest common factors
- Exploring prime numbers
- Solve problems using common multiples and lowest common multiples
- Explore powers and roots

Possible key learning points

- Find common factors of numbers
- Find the highest common factor of numbers, including co-prime
- Recognise and solve problems involving highest common factor
- Find prime numbers and test numbers to see if they are prime
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- Recognise and solve problems involving the lowest common multiple
- Read, write and evaluate powers
- Recognise and use triangular, square and cube numbers
- Define and find square roots (including using the $\sqrt{\square}$ symbol)
- Define and find cube roots (including using the $\sqrt[3]{\square}$ symbol), including the use of a scientific calculator
- Define and find other roots (including using the a $\sqrt[\square]{\square}$ symbols), including the use of a scientific calculator
- Recognise and use simple arithmetic progressions

Prerequisites

- Know how to find common multiples of two given numbers
- Know how to find common factors of two given numbers
- Recall multiplication facts to 12 × 12 and associated division facts

Bring on the Maths+: Moving on up!
Number and Place Value: #6

Prerequisites for the suggested key learning points.

Numbers and the number system — 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
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Possible themes

- Solve problems using common factors and highest common factors
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Possible key learning points

- Find common factors of numbers
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- Define and find other roots (including using the a $\sqrt[\square]{\square}$ symbols), including the use of a scientific calculator
- Recognise and use simple arithmetic progressions

Prerequisites

- Know how to find common multiples of two given numbers
- Know how to find common factors of two given numbers
- Recall multiplication facts to 12 × 12 and associated division facts

Bring on the Maths': Moving on up!
Number and Place Value: #6

Mathematical language

((Lowest) common) multiple and LCM
((Highest) common) factor and HCF
Power
(Square and cube) root
Triangular number, Square number, Cube number, Prime number
Linear sequence

Notation
Index notation: e.g. 5^3 is read as '5 to the power of 3' and means '3 lots of 5 multiplied together'
Radical notation: e.g. $\sqrt{49}$ is generally read as 'the square root of 49' and means 'the positive square root of 49'; $\sqrt[3]{8}$ means 'the cube root of 8'

The **mathematical language** section includes key vocabulary for the unit and information about the **notation** that students need to understand

Numbers and the number system — 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

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Prerequisites

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Bring on the Maths': Moving on up!
Number and Place Value: #6

Mathematical language

((Lowest) common) multiple and LCM
((Highest) common) factor and HCF
Power
(Square and cube) root
Triangular number, Square number, Cube number, Prime number
Linear sequence

Pedagogical notes

Pupils need to know how to use a scientific calculator to work out powers and roots.
Note that while the square root symbol (√) refers to the positive square root of a number, every positive number has a negative square root too.
NCETM: Departmental workshop: Index Numbers
NCETM: Glossary

Common approaches
The following definition of a prime number should be used in order to minimise confusion about 1: A prime number is a number with exactly two factors.
Every classroom has a set of number classification posters on the wall

Pedagogical notes are relevant for all, but particularly beneficial for non-specialists and inexperienced teachers. **Common approaches** are shown in italics as they should be noted in a scheme of work but could be personalised to a school.

Addressing comments in Ofsted's summary reports, 'Understanding the Score' (2007) and 'Made to Measure' (2010)

Numbers and the number system — 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
- use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5
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Return to overview

Possible themes

- Solve problems using common factors and highest common factors
- Exploring prime numbers
- Solve problems using common multiples and lowest common multiples
- Explore powers and roots

Possible key learning points

- Find common factors of numbers
- Find the highest common factor of numbers, including co-prime
- Recognise and solve problems involving
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See *Mathematics Survey Visits: Quality of Teaching in Mathematics (supplementary subject-specific guidance), Ofsted, 2014*

Possible misconceptions highlight some incorrect thinking that students might demonstrate (not mistakes). Thought should be given as to how to exploit these.

Prerequisites

- Know how to find common m
- Know how to find common fa
- Recall multiplication facts to

Bring on the Maths': Moving on
Number and Place Value: #6

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roots.
Note that while the square root symbol (√) refers to the positive square root of a number, every positive number has a negative square root too.
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Common approaches
The following definition of a prime number should be used in order to minimise confusion about 1: A prime number is a number with exactly two factors.
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Possible misconceptions

- Many pupils believe that 1 is a prime number – a misconception which can arise if the definition is taken as 'a number which is divisible by itself and 1'
- A common misconception is to believe that $5^3 = 5 \times 3 = 15$
- See pedagogical note about the square root symbol too

See *Embedding Formative Assessment, Wiliam, 2011* and *Learning from Mistakes and Misconceptions, (Standards Unit: Improving Learning in Mathematics)*

Numbers and the number system — 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
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Return to overview

Possible themes

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Possible key learning points

- Find common factors of numbers
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Reasoning opportunities and **probing questions** utilise question stems suggested as particularly effective following research by John Mason and Anne Watson

Prerequisites

- Know how to find common multiples of two given numbers
- Know how to find common factors of two given numbers
- Recall multiplication facts to 12 × 12 and associated division facts

Bring on the Maths': Moving on up!
Number and Place Value: #6

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Index Numbers

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Reasoning opportunities and probing questions

- When using Eratosthenes sieve to identify prime numbers, why is there no need to go further than the multiples of 7? If this method was extended to test prime numbers up to 200, how far would you need to go? Convince me.
- Kenny says '20 is a square number because $10^2 = 20$'. Explain why Kenny is wrong. Kenny is partially correct. How could he change his statement so that it is fully correct?
- Always / Sometimes / Never: The lowest common multiple of two numbers is found by multiplying the two numbers together.

See Questions and Prompts for Mathematical Thinking , Watson & Mason, 1998, (ATM)

Possible misconceptions

- Many pupils believe that 1 is a prime number – a misconception which can arise if the definition is taken as 'a number which is divisible by itself and 1'
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Numbers and the number system — 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

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Return to overview

Possible themes

- Solve problems using common factors and highest common factors
- Exploring prime numbers
- Solve problems using common multiples and lowest common multiples
- Explore powers and roots

Suggested activities include links to carefully chosen resources including kangaroomaths.com, nrich.maths.org and ncetm.org.uk

Possible key learning points

- Find common factors of numbers
- Find the highest common factor of numbers, including co-prime
- Recognise and solve problems involving highest common factor
- Find prime numbers and test numbers to see if they are prime
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- Read, write and evaluate powers
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- Recognise and use simple arithmetic progressions

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Radical notation: e.g. $\sqrt{49}$ is generally read as 'the square root of 49' and means 'the positive square root of 49'; $\sqrt[3]{8}$ means 'the cube root of 8'

Pedagogical notes

Pupils need to know how to use a scientific calculator to work out powers and roots.
Note that while the square root symbol (√) refers to the positive square root of a number, every positive number has a negative square root too.
NCETM: Departmental workshop: Index Numbers
NCETM: Glossary

Common approaches
The following definition of a prime number should be used in order to minimise confusion about 1: A prime number is a number with exactly two factors.
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Reasoning opportunities and probing questions

- When using Eratosthenes sieve to identify prime numbers, why is there no need to go further than the multiples of 7? If this method was extended to test prime numbers up to 200, how far would you need to go? Convince me.
- Kenny says '20 is a square number because $10^2 = 20$'. Explain why Kenny is wrong. Kenny is partially correct. How could he change his statement so that it is fully correct?
- Always / Sometimes / Never: The lowest common multiple of two numbers is found by multiplying the two numbers together.

Suggested activities

KM: Perfect numbers: includes use of factors, primes and powers
KM: Exploring primes activities: Factors of square numbers; Mersenne primes; LCM sequence; n^2 and $(n + 1)^2$; n^2 and $n^2 + n$; $n^2 + 1$; $n! + 1$; $n! - 1$; $x^2 + x + 41$
KM: Use the method of Eratosthenes' sieve to identify prime numbers, but on a grid 6 across by 17 down instead. What do you notice?
KM: Square number puzzle
KM: History and Culture: Goldbach's Conjectures
NRICH: Factors and multiples
NRICH: Powers and roots

Learning review
KM: 7M1 BAM Task

Possible misconceptions

- Many pupils believe that 1 is a prime number – a misconception which can arise if the definition is taken as 'a number which is divisible by itself and 1'
- A common misconception is to believe that $5^3 = 5 \times 3 = 15$
- See pedagogical note about the square root symbol too

Numbers and the number system — 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Number and Place Value progression map

- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor and lowest common multiple
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Return to overview

Possible themes

- Solve problems using common factors and highest common factors
- Exploring prime numbers
- Solve problems using common multiples and lowest common multiples
- Explore powers and roots

Possible key learning points

- Find common factors of numbers
- Find the highest common factor of numbers, including co-prime
- Recognise and solve problems involving highest common factor
- Find prime numbers and test numbers to see if they are prime
- Find common multiples of numbers
- Recognise and solve problems involving the lowest common multiple
- Read, write and evaluate powers
- Recognise and use triangular, square and cube numbers
- Define and find square roots (including using the $\sqrt{\square}$ symbol)
- Define and find cube roots (including using the $\sqrt[3]{\square}$ symbol), including the use of a scientific calculator
- Define and find other roots (including using the a $\sqrt[\square]{\square}$ symbols), including the use of a scientific calculator
- Recognise and use simple arithmetic progressions

Prerequisites

- Know how to find common multiples of two given numbers
- Know how to find common factors of two given numbers
- Recall multiplication facts to 12 × 12 and associated division facts

Bring on the Maths': Moving on up!
Number and Place Value: #6

Mathematical language

((Lowest) common) multiple and LCM
((Highest) common) factor and HCF
Power
(Square and cube) root
Triangular number, Square number, Cube number, Prime number
Linear sequence

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Index notation: e.g. 5^3 is read as '5 to the power of 3' and means '3 lots of 5 multiplied together'
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Common approaches
The following definition of a prime number should be used in order to minimise confusion about 1: A prime number is a number with exactly two factors.
Every classroom has a set of number classification posters on the wall

Reasoning opportunities and probing questions

- When using Eratosthenes sieve to identify prime numbers, why is there no need to go further than the multiples of 7? If this method was extended to test prime numbers up to 200, how far would you need to go? Convince me.
- Kenny says '20 is a square number because $10^2 = 20$'. Explain why Kenny is wrong. Kenny is partially correct. How could he change his statement so that it is fully correct?
- Always / Sometimes / Never: The lowest common multiple of two numbers is found by multiplying the two numbers together.

Suggested activities

KM: Perfect numbers: includes use of factors, primes and powers
KM: Exploring primes activities: Factors of square numbers; Mersenne primes; LCM sequence; n^2 and $(n + 1)^2$; n^2 and $n^2 + n$; $n^2 + 1$; $n! + 1$; $n! - 1$; $x^2 + x + 41$
KM: Use the method of Eratosthenes' sieve to identify prime numbers, but on a grid 6 across by 17 down instead. What do you notice?
KM: Square number puzzle
KM: History and Culture: Goldbach's Conjectures
NRICH: Factors and multiples
NRICH: Powers and roots

Learning review
KM: 7M1 BAM Task

Possible misconceptions

- Many pupils believe that 1 is a prime number – a misconception which can arise if the definition is taken as 'a number which is divisible by itself and 1'
- A common misconception is to believe that $5^3 = 5 \times 3 = 15$
- See pedagogical note about the square root symbol too

Pitch of the Secondary Schemes of Work

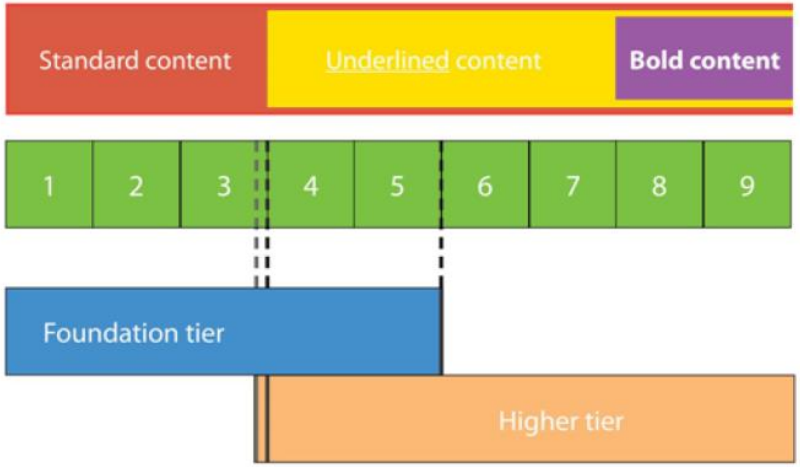

Diagram from www.ocr.org.uk/gcsemaths

Scheme of Work	Source of content
Stage 5	Year 5 Programme of Study
Stage 6	Year 6 Programme of Study
Stage 7	**Standard** content: 9 – 1 GCSE Specification
Stage 8	**Standard** content: 9 – 1 GCSE Specification
Stage 9	**Underlined** content: 9 – 1 GCSE Specification
Stage 10	**Underlined/Bold** content: 9 – 1 GCSE Specification
Stage 11	**Bold** content: 9 – 1 GCSE Specification