

Butler's Hill Mathematical Thinking & Reasoning Handbook



Section I – Vision & Principles

Purpose

This handbook supports high-quality mathematical thinking from Nursery to Year 2. It is aligned with White Rose Maths, NCETM Mastering Number, NRICH and the EEF guidance on improving mathematics. The aim is to help every adult consistently promote reasoning, explanation, justification and problem solving.

Why reasoning matters

Children develop deep mathematical understanding when they explain, justify, represent, compare and prove their ideas. Reasoning should be woven through every lesson rather than taught separately.

The Butler's Hill approach

We expect all pupils to notice patterns, explain their thinking, justify answers, make connections, spot mistakes, prove ideas and use precise mathematical vocabulary.

NCETM Five Big Ideas

Teaching should promote coherence, mathematical representation, mathematical structure, fluency and variation so that pupils develop secure conceptual understanding.

White Rose mastery principles

Small steps, careful sequencing, rich discussion, multiple representations and opportunities to deepen understanding are embedded across the curriculum.

NRICH influence

Tasks should encourage investigation, multiple solutions, justification, collaboration and resilience rather than simply finding answers.

Teacher expectations

Every lesson should include opportunities to ask 'How do you know?', 'Can you convince me?', 'Will this always be true?' and 'Can you prove it?'. Teachers should routinely use misconceptions and multiple representations to deepen understanding.

Whole-School Non-Negotiables

- Every lesson includes mathematical talk.
- Children explain before recording where appropriate.
- Teachers use stem sentences and precise vocabulary.
- Reasoning questions are planned, not incidental.

- Misconceptions are explored positively.
- All children are expected to reason, not only higher attainers.

Section 2 – Whole-School Progression of Mathematical Thinking

This progression sets out how mathematical thinking develops from Nursery to Year 2. The expectations are cumulative, with each year building on the previous one. Teachers should revisit and model the language from earlier phases throughout the curriculum.

Year Group	Mathematical Thinking	Stem Sentences	Teacher Questions	Expected Reasoning	Evidence in the Classroom
Nursery	Notice, sort, compare and describe.	I notice... It is the same because... It is different because...	What do you notice? Can you show me? Which has more? How do you know?	Children describe, compare and explain using everyday language.	Adults hear mathematical talk during play and model vocabulary.
Reception	Explain, compare and begin to justify.	I know because... I think... I chose... They are equal because...	Why? How do you know? Can you find another? Which doesn't belong?	Children explain choices and compare representations.	Children use mathematical vocabulary confidently in discussion.
Year 1	Justify, represent and make connections.	I can prove... I noticed... Another way is... The pattern is...	Convince me. What changed? What stayed the same? Is it always true?	Children explain methods, spot patterns and compare strategies.	Children respond using full mathematical sentences and multiple representations.

Year 2	Generalise, prove and evaluate.	I know this must be true because... My rule is... I can prove...	Will this always happen? Can you prove it? Can you find a counter-example? Which method is most efficient?	Children justify efficiently, generalise patterns and critique reasoning.	Children independently explain, justify and challenge mathematical ideas.
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Progression of Reasoning Question Types

Notice: What do you notice? • What is the same? • What is different?

Explain: How do you know? • Tell me why. • Convince me.

Predict: What might happen next? • What if...?

Generalise: Will this always happen? • Can you make a rule?

Prove: Can you prove it? • Can anyone disagree?

Evaluate: Which method is most efficient? • Why?

Whole-School Non-Negotiables for Mathematical Talk

- Every lesson includes planned reasoning opportunities.
- All pupils explain their thinking, not just volunteers.
- Teachers use misconceptions to deepen understanding.
- Representations are compared and discussed.
- Children are encouraged to agree, disagree and justify respectfully.
- Reasoning is embedded across fluency, problem solving and application.

Section 3 – Nursery

The prompts below are designed to support high-quality mathematical talk during adult-led sessions and continuous provision. They align with the mathematical behaviours promoted through White Rose Maths, NCETM and NRICH.

Match, Sort & Compare

Learning Focus	Compare objects by colour, size, shape and attribute.
Key Vocabulary	same, different, match, sort, group, more, fewer
Stem Sentences	• I notice... • They are the same because... • This belongs here because...
Teacher Questions	• What do you notice? • How are these the same? • How are they different? • Can you find another? • Can you sort them a different way?
Common Misconception	Child sorts by one attribute only.
Greater Depth	Can you sort these in two different ways?
Odd One Out	One object does not belong. Explain why.
True / False	All red objects belong together. Is that always true?
Continuous Provision Prompt	Listen for children explaining, comparing, justifying and using mathematical vocabulary while playing. Model reasoning through open-ended questioning.

Pattern

Learning Focus	Copy, continue and create repeating patterns.
Key Vocabulary	pattern, repeat, next, before, after
Stem Sentences	• My pattern is... • It repeats because...
Teacher Questions	• What comes next? • How do you know? • Can you make your own pattern? • Can you spot the mistake?
Common Misconception	Believes any sequence is a pattern.
Greater Depth	Create a pattern with three objects.
Odd One Out	Find the mistake in a repeating pattern.
True / False	A pattern must always use two colours. True or false?
Continuous Provision Prompt	Listen for children explaining, comparing, justifying and using mathematical vocabulary while playing. Model reasoning through open-ended questioning.

Numbers to 5

Learning Focus	Develop secure counting and cardinality to 5.
Key Vocabulary	count, more, less, equal, altogether

Stem Sentences	• I counted... • There are... • I know because...
Teacher Questions	• How many? • How do you know? • Can you show me another way? • Which has more?
Common Misconception	Counts objects but recounts without trusting the total.
Greater Depth	Can you make 5 in different ways?
Odd One Out	Two groups both have 4. How do you know?
True / False	If I move the objects, does the number change?
Continuous Provision Prompt	Listen for children explaining, comparing, justifying and using mathematical vocabulary while playing. Model reasoning through open-ended questioning.

Section 4 – Reception

These prompts support Reception teachers in developing deep mathematical understanding through discussion, reasoning and purposeful questioning. They are designed to complement White Rose Maths, NCETM Mastering Number and NRICH approaches.

Match, Sort & Compare

Learning Focus	Compare and classify objects by different attributes.
Key Vocabulary	same, different, sort, group, compare
Stem Sentences	• I notice... • I sorted them because... • They are the same because...
Teacher Questions	• What do you notice? • Can you sort them another way? • Which doesn't belong? Why? • Can you explain your thinking?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Children believe there is only one correct way to sort objects.
Greater Depth	Sort the same objects in three different ways.
Representation Ideas	Use real objects and ask children to justify each classification.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

Numbers to 5

Learning Focus	Develop secure understanding of quantity to 5.
Key Vocabulary	more, fewer, equal, altogether, five
Stem Sentences	• I know there are... • I counted... • I can see...
Teacher Questions	• How do you know? • Can you show 5 another way? • What if I move them? • Is there another representation?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Children recount after rearranging objects.
Greater Depth	Find every way to make 5.
Representation Ideas	Use fingers, ten frames, dice and part-whole models.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

Alive in 5

Learning Focus	Explore composition of numbers within 5.
Key Vocabulary	part, whole, altogether
Stem Sentences	• The whole is... • The parts are...
Teacher Questions	• What has changed? • What stayed the same? • Can you prove it?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Thinks changing order changes the total.
Greater Depth	Find all pairs making 5.
Representation Ideas	Use part-whole models and counters.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

Mass & Capacity

Learning Focus	Compare and order objects.
Key Vocabulary	heavy, light, full, empty, balance
Stem Sentences	• I think... because...

Teacher Questions	• How could we check? • Can you predict? • Why?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Judges only by size.
Greater Depth	Order several objects and justify.
Representation Ideas	Use balance scales and containers.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

6, 7 & 8

Learning Focus	Build secure understanding of numbers 6–8.
Key Vocabulary	six, seven, eight, more, less
Stem Sentences	• I know because... • I can see...
Teacher Questions	• Can you represent it differently? • Which representation is easiest?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Counts instead of subitising familiar patterns.
Greater Depth	Find all ways to make 8.
Representation Ideas	Use rekenrek, tens frame and cubes.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

Length, Height & Time

Learning Focus	Compare and measure informally.
Key Vocabulary	long, short, taller, shorter, before, after
Stem Sentences	• It is longer because...
Teacher Questions	• How do you know? • Can you compare without measuring?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Only compares by eye when direct comparison needed.
Greater Depth	Explain your reasoning when ordering.
Representation Ideas	Measure with non-standard units.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

Building 9 & 10

Learning Focus	Compose and decompose 9 and 10.
Key Vocabulary	part, whole, ten
Stem Sentences	• Ten is made from...
Teacher Questions	• Can you prove there are 10? • Is there another way?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Thinks only one partition exists.
Greater Depth	Find every partition of 10.
Representation Ideas	Use ten frames and double dice.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

3D Shape

Learning Focus	Describe and compare 3D shapes.
Key Vocabulary	face, edge, corner, roll, stack
Stem Sentences	• I know it is... because...
Teacher Questions	• Why won't it roll? • Which doesn't belong?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Names by appearance only.
Greater Depth	Find two shapes with the same property.
Representation Ideas	Build and investigate.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

To 20 & Beyond

Learning Focus	Extend number understanding beyond 10.
Key Vocabulary	teen, ten and..., more, less
Stem Sentences	• I know because...
Teacher Questions	• What pattern do you notice? • What if we add one more? • Will this always happen?
NCETM Big Idea	Representation and structure, mathematical thinking and coherence.
Mastering Number Focus	Encourage subitising, composition, comparison and explanation.
Common Misconception	Counts all instead of recognising ten and ones.
Greater Depth	Represent numbers in multiple ways.

Representation Ideas	Use bead strings, rekenrek and place value charts.
NRICH-style Prompt	Can you find another way? Convince your partner. Is there more than one correct answer?

Measure

Learning Focus	Compare length, mass and capacity through play.
Key Vocabulary	long, short, heavy, light, full, empty
Stem Sentences	• This is longer because... • This is heavier because...
Teacher Questions	• Which is heavier? • How could we check? • Can you find something longer?
Common Misconception	Judges by appearance only.
Greater Depth	Can you order three objects?
Odd One Out	Explain why one object is longer.
True / False	The tallest object is always the heaviest. True or false?
Continuous Provision Prompt	Listen for children explaining, comparing, justifying and using mathematical vocabulary while playing. Model reasoning through open-ended questioning.

Shape & Space

Learning Focus	Recognise, describe and manipulate 2D and 3D shapes.
Key Vocabulary	side, corner, round, roll, stack
Stem Sentences	• I know it is a... because...
Teacher Questions	• What do you notice? • Which doesn't belong? • Can you build with these? • Why won't it roll?
Common Misconception	Names shapes by appearance only.
Greater Depth	Find two different shapes with the same property.
Odd One Out	Odd one out with justification.
True / False	All circles roll. Why?
Continuous Provision Prompt	Listen for children explaining, comparing, justifying and using mathematical vocabulary while playing. Model reasoning through open-ended questioning.

Section 5 – Year 1

Reasoning prompts linked to Year 1 White Rose units. Use these alongside fluency and practical resources to deepen mathematical understanding.

Place Value within 10

Learning Focus	Understand numbers to 10.
Key Vocabulary	part, whole, digit
Stem Sentences	I know because... I noticed...
Teacher Questions	What do you notice? Can you represent it another way? Will this always be true?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Counters, tens frames
Common Misconception	Confuses numeral with quantity.
Greater Depth Challenge	Build the same number four ways.
True or False?	Tom says 7 is always one more than 6.
Always, Sometimes, Never	The biggest number always has the most digits.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Addition & Subtraction within 10

Learning Focus	Relationships between addition and subtraction.
Key Vocabulary	add, subtract
Stem Sentences	I partitioned... My method was...
Teacher Questions	Which method is most efficient? Can you prove it?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Part-whole, number lines
Common Misconception	Treats addition and subtraction separately.
Greater Depth Challenge	Three calculations with same answer.
True or False?	$3+5$ is different from $5+3$.
Always, Sometimes, Never	Adding always makes numbers bigger.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Shape

Learning Focus	Describe 2D and 3D shapes.
Key Vocabulary	side, corner, face
Stem Sentences	I know it is... because...
Teacher Questions	Which doesn't belong? What is the same?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Sorting hoops
Common Misconception	Names by appearance.
Greater Depth Challenge	Find two shapes with same property.
True or False?	A square is not a rectangle.
Always, Sometimes, Never	All four-sided shapes are squares.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Place Value within 20

Learning Focus	Secure teen numbers.
Key Vocabulary	teen, ones
Stem Sentences	Ten and... makes...
Teacher Questions	How do you know? Can you prove it?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Base ten
Common Misconception	Counts all objects.
Greater Depth Challenge	Represent 17 four ways.
True or False?	17 is only $10+7$.
Always, Sometimes, Never	Teen numbers always begin with 1.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Addition & Subtraction within 20

Learning Focus	Develop efficient strategies.
Key Vocabulary	bridge, partition
Stem Sentences	I used... because...
Teacher Questions	Which strategy is best? Can you solve it another way?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Dienes
Common Misconception	Counts everything.

Greater Depth Challenge	Compare two methods.
True or False?	This method always works.
Always, Sometimes, Never	Subtraction always makes numbers smaller.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Place Value within 50

Learning Focus	Count in tens and ones.
Key Vocabulary	tens, ones
Stem Sentences	There are... tens...
Teacher Questions	What pattern do you notice?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Base ten
Common Misconception	Confuses place value.
Greater Depth Challenge	Generalise patterns.
True or False?	Adding 10 changes both digits.
Always, Sometimes, Never	Adding 10 only changes the tens digit.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Length & Height

Learning Focus	Measure accurately.
Key Vocabulary	longer, shorter
Stem Sentences	I measured...
Teacher Questions	How could we check?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Rulers
Common Misconception	Starts ruler at 1.
Greater Depth Challenge	Measure several objects.
True or False?	Longer means heavier.
Always, Sometimes, Never	Always use same unit.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Mass & Volume

Learning Focus	Compare mass and capacity.
Key Vocabulary	heavy, light
Stem Sentences	I know because...

Teacher Questions	Can you estimate?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Scales
Common Misconception	Judges by size.
Greater Depth Challenge	Explain your order.
True or False?	Bigger means heavier.
Always, Sometimes, Never	Tallest holds the most.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Multiplication & Division

Learning Focus	Equal groups and arrays.
Key Vocabulary	groups, equal
Stem Sentences	There are... groups...
Teacher Questions	Can you draw an array?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Counters
Common Misconception	Counts instead of grouping.
Greater Depth Challenge	Different arrays.
True or False?	3×4 differs from 4×3 .
Always, Sometimes, Never	Arrays only show multiplication.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Fractions

Learning Focus	Halves and quarters.
Key Vocabulary	half, quarter
Stem Sentences	Each part is equal because...
Teacher Questions	Why must they be equal?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Shapes
Common Misconception	Accepts unequal parts.
Greater Depth Challenge	Find incorrect examples.
True or False?	Any two pieces are halves.
Always, Sometimes, Never	All halves look the same.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Position & Direction

Learning Focus	Describe movement.
Key Vocabulary	left, right
Stem Sentences	I moved...
Teacher Questions	Explain the route.
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Bee-Bots
Common Misconception	Left/right confusion.
Greater Depth Challenge	Create routes.
True or False?	Quarter turn always faces east.
Always, Sometimes, Never	Left never changes.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Place Value within 100

Learning Focus	Count in tens.
Key Vocabulary	tens
Stem Sentences	I know because...
Teacher Questions	What stays the same?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Dienes
Common Misconception	Counts in ones.
Greater Depth Challenge	Spot patterns.
True or False?	100 has one digit.
Always, Sometimes, Never	All tens end in zero.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Money

Learning Focus	Recognise coins.
Key Vocabulary	coin, pence
Stem Sentences	I chose...
Teacher Questions	Can you make it another way?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Coins
Common Misconception	Coin size=value.
Greater Depth Challenge	Different combinations.
True or False?	10p > two 5ps.
Always, Sometimes, Never	Biggest coin highest value.

NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.
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Time

Learning Focus	Hours and half hours.
Key Vocabulary	hour
Stem Sentences	The hands show...
Teacher Questions	How do you know?
Ready-to-Progress Focus	Secure conceptual understanding before formal methods.
NCETM Representation Ideas	Clocks
Common Misconception	Reads one hand only.
Greater Depth Challenge	Explain routines.
True or False?	Half past means half left.
Always, Sometimes, Never	Short hand never moves.
NRICH-style Prompt	Can you find another way? Convince your partner your answer is correct.

Section 6 – Year 2

Reasoning prompts linked to the Year 2 White Rose Maths curriculum. These support pupils in explaining, justifying, proving and generalising mathematical ideas using appropriate representations.

Place Value

Learning Focus	Secure understanding of numbers to 100.
Key Vocabulary	hundreds, tens, ones, compare, order
Stem Sentences	I know because... The value of the digit is... I noticed...
Teacher Questions	What do you notice? Can you represent it another way? What changes if you exchange one ten for ten ones? Will this always be true?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Base ten, place value charts
Common Misconception	Confuses digit with value.
Greater Depth Challenge	Represent 68 in five different ways.
True or False?	Eva says 52 has five ones. Explain.
Always, Sometimes, Never	The greatest number always has the largest tens digit.

NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?
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Addition & Subtraction

Learning Focus	Use efficient mental and written strategies.
Key Vocabulary	partition, exchange, inverse
Stem Sentences	I chose this method because... I can prove...
Teacher Questions	Which method is most efficient? Can you solve it another way? How do you know your answer is correct?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Base ten, number lines
Common Misconception	Uses one strategy regardless of calculation.
Greater Depth Challenge	Compare three methods and justify the most efficient.
True or False?	372–128 is impossible without exchanging.
Always, Sometimes, Never	The inverse always checks the answer.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Money

Learning Focus	Calculate with pounds and pence.
Key Vocabulary	pounds, pence, total, change
Stem Sentences	I know because... My change is...
Teacher Questions	Can you find another combination? Which is the cheapest way? How do you know?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Coins, price tags
Common Misconception	Treats £ and p interchangeably.
Greater Depth Challenge	Find all combinations making £1.
True or False?	20p + 30p = £50.
Always, Sometimes, Never	Using more coins always means more money.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Multiplication & Division

Learning Focus	Develop fluency with facts and structures.
Key Vocabulary	factor, product, array, groups
Stem Sentences	The factor tells us... The product is...
Teacher Questions	What pattern do you notice? Can you prove $4 \times 6 = 6 \times 4$? Can you create another array?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Arrays, counters
Common Misconception	Counts in ones rather than equal groups.
Greater Depth Challenge	Find all factor pairs of 24.
True or False?	3×8 is larger than 8×3 .
Always, Sometimes, Never	Multiplication always makes numbers bigger.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Length & Height

Learning Focus	Measure and compare accurately.
Key Vocabulary	metre, centimetre, estimate
Stem Sentences	I estimated... I measured...
Teacher Questions	Why did you choose that unit? How could we check?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Rulers, metre sticks
Common Misconception	Chooses inappropriate units.
Greater Depth Challenge	Explain and justify estimates.
True or False?	1 m is shorter than 100 cm.
Always, Sometimes, Never	Longer objects are always heavier.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Mass, Capacity & Temperature

Learning Focus	Compare and solve measure problems.
Key Vocabulary	grams, kilograms, litres
Stem Sentences	I know because... The scale shows...
Teacher Questions	Can you estimate first? What would happen if...?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Scales, measuring jugs
Common Misconception	Reads scales inaccurately.
Greater Depth Challenge	Compare two measuring methods.
True or False?	1000 g is greater than 1 kg.
Always, Sometimes, Never	Heavier always means bigger.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Fractions

Learning Focus	Recognise, compare and calculate fractions.
Key Vocabulary	half, quarter, third, numerator, denominator
Stem Sentences	The whole is... Each part is equal because...
Teacher Questions	How do you know the parts are equal? Can you find another representation?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Fraction strips
Common Misconception	Counts pieces rather than equal parts.
Greater Depth Challenge	Show one half in four different ways.
True or False?	Two quarters are less than one half.
Always, Sometimes, Never	All fractions are less than one.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Time

Learning Focus	Tell and solve problems involving time.
Key Vocabulary	o'clock, half past, quarter past, minutes
Stem Sentences	The clock shows... I know because...

Teacher Questions	How long has passed? Can you prove it another way?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Clocks
Common Misconception	Confuses hour and minute hands.
Greater Depth Challenge	Compare analogue and digital times.
True or False?	Quarter past means 25 minutes.
Always, Sometimes, Never	The hour hand never moves between numbers.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Statistics

Learning Focus	Interpret pictograms and block graphs.
Key Vocabulary	most, least, total
Stem Sentences	I can see... The graph tells me...
Teacher Questions	What do you notice? Can you compare the data? What questions could you ask?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Graphs
Common Misconception	Reads symbols as single items.
Greater Depth Challenge	Create your own graph and questions.
True or False?	There are more categories than data.
Always, Sometimes, Never	The tallest bar always means double.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Position & Direction

Learning Focus	Describe movement using mathematical language.
Key Vocabulary	clockwise, anticlockwise, quarter turn
Stem Sentences	I turned... I moved...
Teacher Questions	Can you describe another route? Which route is most efficient?
Ready-to-Progress Focus	Develop secure conceptual understanding before increasing complexity.
NCETM Representation Ideas	Floor robots

Common Misconception	Confuses clockwise and anticlockwise.
Greater Depth Challenge	Design and explain a route.
True or False?	Two quarter turns are different from one half turn.
Always, Sometimes, Never	Turning changes your position.
NRICH-style Prompt	Can you find another method? Convince someone that your answer must be correct. Can you create your own example?

Section 7 – NRICH-Style Investigations

These open-ended investigations are inspired by the principles promoted through NRICH. The emphasis is on noticing patterns, making conjectures, testing ideas, explaining reasoning and finding more than one solution. The activities are intended to complement White Rose Maths rather than replace it.

Nursery – Sorting Challenge

Purpose	Provide a collection of natural objects. Ask children to sort them in as many different ways as they can.
Teacher Prompts	• How did you decide? • Can you sort them another way? • Which object could belong in two groups? • Can anyone think differently?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Reception – How Many Ways?

Purpose	Investigate all the ways to make 5, then 10 using counters, ten frames and fingers.
Teacher Prompts	• How do you know you've found them all? • Which representations are the same? • Can you convince your partner? • What pattern do you notice?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Year 1 – Missing Numbers

Purpose	Create equations with missing numbers and encourage children to find more than one solution.
Teacher Prompts	• Is there another answer? • Will your method always work? • Can you prove it? • Can you make a harder one?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Year 1 – Shape Detective

Purpose	Investigate properties of 2D and 3D shapes using sorting hoops.
Teacher Prompts	• Which doesn't belong? • Can you justify your choice? • Can a shape belong in two groups? • What is always true?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Year 2 – Always, Sometimes, Never

Purpose	Explore statements such as 'Adding 10 only changes the tens digit' or 'Multiplication always makes numbers bigger'.
Teacher Prompts	• Always? Sometimes? Never? • Can you find an example? • Can you find a counter-example? • Can you explain why?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and

	recognise there may be more than one correct solution.
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Year 2 – Convince Me

Purpose	Present two different methods for solving the same calculation and ask children to evaluate them.
Teacher Prompts	• Which method is more efficient? • Would both always work? • Can you convince the class? • Can you represent it another way?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Whole School – Odd One Out

Purpose	Present four numbers, shapes or representations and ask children which one does not belong.
Teacher Prompts	• Could there be another answer? • Can you justify it? • Can you persuade someone else? • What mathematical language helped you?
Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Whole School – Create the Rule

Purpose	Show a sequence or pattern and ask children to discover the rule before creating their own.
Teacher Prompts	• What is changing? • What stays the same? • Will the pattern continue? • Can someone make a different rule?

Mathematical Behaviours	Notice • Explain • Justify • Generalise • Prove • Reflect
Success Criteria	Children explain their thinking, listen to others, justify answers with mathematical language and recognise there may be more than one correct solution.

Planning Checklist

- Choose a low-threshold, high-ceiling task.
- Allow thinking time before discussion.
- Encourage multiple representations.
- Accept more than one correct strategy.
- Use misconceptions as discussion points.
- Finish by asking pupils to generalise or create a similar problem.

Section 8 – Butler's Hill Mathematical Talk Toolkit

This toolkit is designed to help all adults consistently promote mathematical discussion. The prompts can be used in whole-class teaching, guided groups, continuous provision and interventions.

Notice

Teacher Prompt	Purpose
What do you notice?	Encourage observation and pattern spotting.
What is the same?	Encourage observation and pattern spotting.
What is different?	Encourage observation and pattern spotting.
What pattern can you see?	Encourage observation and pattern spotting.

Explain

Teacher Prompt	Purpose
How do you know?	Develop mathematical language and justification.
Tell me why.	Develop mathematical language and justification.
Can you explain your thinking?	Develop mathematical language and justification.
Can you convince me?	Develop mathematical language and justification.

Represent

Teacher Prompt	Purpose
Can you show it another way?	Deepen conceptual understanding through multiple representations.
Can you draw it?	Deepen conceptual understanding through multiple representations.
Can you build it?	Deepen conceptual understanding through multiple representations.
Which representation is clearest?	Deepen conceptual understanding through multiple representations.

Compare

Teacher Prompt	Purpose
Which is greater? Why?	Encourage reasoning between methods and ideas.
How are these alike?	Encourage reasoning between methods and ideas.
How are they different?	Encourage reasoning between methods and ideas.
Which method would you choose?	Encourage reasoning between methods and ideas.

Predict

Teacher Prompt	Purpose
What might happen next?	Promote conjecture before calculation.
What if I changed...?	Promote conjecture before calculation.
Can you estimate first?	Promote conjecture before calculation.
Will your answer change?	Promote conjecture before calculation.

Generalise

Teacher Prompt	Purpose
Will this always happen?	Help pupils identify mathematical structure.
Can you make a rule?	Help pupils identify mathematical structure.
Can you think of another example?	Help pupils identify mathematical structure.
Can you find a counter-example?	Help pupils identify mathematical structure.

Prove

Teacher Prompt	Purpose
Can you prove it?	Develop justification using evidence.
Can anyone disagree?	Develop justification using evidence.

Can you convince your partner?	Develop justification using evidence.
How do you know it must be true?	Develop justification using evidence.

Reflect

Teacher Prompt	Purpose
What did you learn?	Encourage metacognition and evaluation.
Would another method be better?	Encourage metacognition and evaluation.
What mistake could someone make?	Encourage metacognition and evaluation.
What would you do differently?	Encourage metacognition and evaluation.

Progressive Pupil Sentence Stems

Year Group	Suggested Sentence Stems
Nursery	I notice... • It is the same because... • It is different because...
Reception	I know because... • I think... • I chose... • They are equal because...
Year 1	I can prove... • I noticed... • Another way is... • I disagree because...
Year 2	My rule is... • This will always happen because... • I can prove it by... • A counter-example is...

Teaching Assistant Prompt Card

- Wait at least 5 seconds before intervening.
- Ask 'How do you know?' before telling.
- Encourage children to explain to each other.
- Ask for another method or representation.
- Use manipulatives before abstract recording.
- Praise reasoning, not just correct answers.

Learning Walk Look-Fors

- Children using mathematical vocabulary accurately.
- Teachers planning reasoning opportunities.
- Multiple representations visible.
- Children justifying answers with confidence.
- Misconceptions explored positively.
- Reasoning evident in books, discussion and practical activities.

Section 9 – Assessment & Evidence of Reasoning

This section supports formative assessment by identifying what successful mathematical reasoning looks like in lessons, books and pupil discussions. The prompts are intended for teachers, teaching assistants and leaders during everyday assessment, learning walks and book looks.

1. Formative Assessment Questions

- How do you know your answer is correct?
- Can you prove it in another way?
- What representation could you use?
- Can you explain your thinking to a partner?
- What has stayed the same? What has changed?
- Will this always be true? Why?
- Can you find a mistake?
- Can you create your own example?

2. Evidence of Reasoning in Lessons

Look-for	Evidence
Mathematical talk	Children explain, justify and challenge ideas using accurate vocabulary.
Representations	Children move between concrete, pictorial and abstract representations.
Teacher questioning	Open-ended questions promote explanation rather than recall alone.
Misconceptions	Errors are explored positively and used to deepen understanding.
Participation	All pupils are expected to reason, not only the most confident.

3. Book Scrutiny Look-Fors

- Evidence of explanation alongside calculations.
- Use of diagrams, models or representations.
- Reasoning challenges completed.
- Children correcting misconceptions.
- Progression from fluency to reasoning and problem solving.

4. Pupil Voice Questions

- How did you work that out?
- Could someone solve it differently?
- What helped you today?
- What would you do if you got stuck?

- Which mathematical equipment helps you most? Why?
- What does 'prove it' mean in maths?

5. Assessment Rubric

Developing	Secure	Deep	Evidence
Explains answers with support.	Explains and justifies independently.	Generalises, proves and evaluates.	Discussion, books, practical work and teacher observation.

6. Learning Walk Prompts

- Are children talking more than the teacher during reasoning opportunities?
- Are sentence stems visible and being used?
- Do adults ask follow-up questions?
- Are misconceptions planned for and discussed?
- Can pupils explain why a method works rather than simply demonstrating it?

7. Butler's Hill Success Criteria

- Reasoning is planned into every maths lesson.
- Children routinely explain and justify answers.
- Adults value thinking processes as much as correct answers.
- Assessment identifies misconceptions and informs next steps.
- Mathematical discussion is a visible feature of every classroom.