

# ECMG Birth to Seven Mathematics Curriculum Review

## Early Years Foundation Stage (EYFS)

### The Educational Programme

#### The issues

- The narrow focus on number with minor mentions of other areas of mathematics create an imbalanced educational programme.
- Most content is appropriate only for the eldest children so does not support developmentally sound practice with younger children.
- Some priority areas, that are key for future mathematics success, are sidelined in the list of examples towards the end of the paragraph.

#### Recommendation

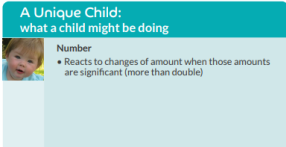
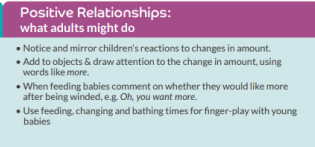
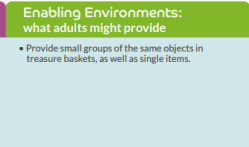

Current Educational Programme	An improved Educational Programme
<p>Developing a strong grounding in number is essential so that all children develop the necessary building blocks to excel mathematically. Children should be able to count confidently, develop a deep understanding of the numbers to 10, the relationships between them and the patterns within those numbers. By providing frequent and varied opportunities to build and apply this understanding - such as using manipulatives, including small pebbles and tens frames for organising counting - children will develop a secure base of knowledge and vocabulary from which mastery of mathematics is built. In addition, it is important that the curriculum includes rich opportunities for children to develop their spatial reasoning skills across all areas of mathematics including shape, space and measures. It is important that children develop positive attitudes and interests in mathematics, look for patterns and relationships, spot connections, 'have a go', talk to adults and peers about what they notice and not be afraid to make mistakes.</p>	<p>Children develop problem solving skills as they begin to use and apply developing mathematical knowledge and understanding.</p> <p>It is important that children develop positive attitudes and interests in mathematics, 'have a go', communicate what they notice and not be afraid to make mistakes.</p> <p>Children need to develop number sense, which includes the key elements of counting, cardinality, ordinality, comparison and composition. Children should learn to count confidently, subitise small numbers and develop a deep understanding of the numbers to 10 and the relationships between them.</p> <p>Developing a strong grounding in spatial reasoning is essential for children's mathematics. They need to explore the properties of objects, the environment and spatial relations in order to develop visualisation of movements and transformations.</p> <p>Mathematics is based on understanding pattern and structure. Children need to look for patterns and explore repeating and spatial patterns, in order to identify relationships, spot connections, reason and generalise.</p>

## The non-statutory guidance

### The issues

- There is little guidance for practitioners working with the youngest children as there is only one age phase for 'Birth to three', with one set of learning statements and examples, despite the significant difference between the learning needs of babies compared with two- and three-year-olds.
- The Reception guidance is disproportionately focused on number, risking children's access to important [spatial](#) and [pattern](#) learning, which are key predictors of future mathematics success.

### Recommendation

Current Development Matters	A research-informed guidance document																								
<p>Birth to three: 6 number, 1 pattern, 1 space, 2 shape and 1 measure</p>	<p><a href="#">Birth to Five Matters</a></p>																								
<p>Nursery: 9 number, 3 pattern, 3 shape, 3 space and 2 measure</p> <p>Year R: 8 number, 1 pattern, 2 shape, 0 space and 1 measure</p>	  																								
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## Early Learning Goals for the end of the Reception Year ('expected level' for all children)

### The issues

- ELGs are perceived as the reception curriculum, due to the high stakes attached. Shape, space and measures risk being neglected areas of mathematics, because they are not included in the ELGS, despite overwhelming evidence that well- developed spatial skills lead to higher attainment in primary mathematics and that these can be taught to young children.
- Pattern is misrepresented in the 'numerical patterns' ELG. The promising research on the potential for early pattern understanding to support later mathematics attainment is for linear repeating patterns (and ability to identify the 'unit of 'repeat') and not for knowledge of specific numerical patterns. It is unclear on what basis numerical patterns were included as one of the two priority areas for five year olds.
- The requirement for children to 'automatically recall' number bonds is not supported by research and could harm future progress and attitudes to maths, due to a focus on learning abstract, context-free facts. It is more important for young children to develop understanding of number composition through a range of practical contexts.
- The Reception Baseline Assessment has a narrow, superficial focus, which also influences the reception curriculum. It is minimally informative and so wastes time, when teachers should be establishing relationships and beginning learning in a more holistic way. Assessments should be formative and [research-based](#), prioritising aspects that children need to secure future progress.
- Problem solving should be included: it is essential for developing understanding of maths, as well as flexibility, creativity and critical thinking

**Recommendation**

Current ELGs	ELGs supported by the priorities for later mathematics success according to research
<p>Children at the expected level of development will:</p> <p><b>Number</b></p> <ul style="list-style-type: none"> <li>• Have a deep understanding of numbers to 10, including the composition of each number.</li> <li>• Subitise (recognise quantities without counting) up to 5.</li> <li>• Automatically recall (without reference to rhymes, counting or other aids)</li> <li>• number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts.</li> </ul> <p><b>Numerical Patterns</b></p> <ul style="list-style-type: none"> <li>• Verbally count beyond 20, recognising the pattern of the counting system.</li> <li>• Compare quantities up to 10 in different contexts, recognising when one</li> <li>• quantity is greater than, less than or the same as the other quantity.</li> <li>• Explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally.</li> </ul>	<p>Children at the expected level of development will solve problems and communicate their thinking, demonstrating that they can:</p> <p><b>Number</b> With numbers to 12:</p> <ul style="list-style-type: none"> <li>• count out a number of objects from a larger group</li> <li>• match numerals to amounts</li> <li>• order, compare and estimate numbers</li> <li>• subitise up to 5 and recognise how numbers are made up of other numbers</li> <li>• add, subtract and share in meaningful contexts</li> </ul> <p><b>Spatial reasoning</b></p> <ul style="list-style-type: none"> <li>• Solve problems involving comparisons and predictions about length/distance, volume/capacity</li> <li>• select and combine shapes for a purpose according to their properties</li> <li>• build complex constructions</li> <li>• follow directions and describe positions and routes</li> </ul> <p><b>Pattern</b></p> <ul style="list-style-type: none"> <li>• begin to identify the rule in a pattern (e.g. unit of repeat) with objects, actions and sounds</li> </ul>

## National Curriculum Year 1

### The issues:

- The content needs to consolidate a broad reception curriculum in order for all children to have sufficient experience of foundational concepts in a wide range of contexts. This will allow younger and less knowledgeable children to develop any missing foundational understanding alongside their peers and prevent future gaps in attainment.
- The curriculum is not the same as the assessment goals and should identify an entitlement to experiences which ensure learning and positive attitudes
- It needs to be based on research evidence with 5 to 6 year-olds, identifying priorities for this age group. These include number sense, patterning and spatial reasoning.
- Problem solving and the [Characteristics of Effective Learning](#) should be identified separately, as well as being included in examples and guidance, in order to support depth of mathematical understanding, developing positive attitudes and mathematical habits of mind, as well as continuity with EYFS.
- Pedagogy should be less focused on seated, written work so it is [developmentally appropriate](#) (in line with international practice). It should include playful interactions and learning based on what children of this age enjoy. Examples could include throwing games, stories, hiding things in boxes, posting, pegging, puzzles, ramps and construction. There should be opportunities for practice, sense-making and discussion in a range of relevant contexts.

### Recommendation

Current programme of study for Year 1	A programme of study based on research evidence
<p>Pupils should be taught to:</p> <p><b>Number and place value</b></p> <ul style="list-style-type: none"> <li>• count to and across 100, forwards and backwards, beginning with 0 or 1, or from any given number</li> <li>• count, read and write numbers to 100 in numerals; count in multiples of twos, fives and tens</li> <li>• given a number, identify one more and one less</li> </ul>	<p>Children develop problem solving skills as they use and apply developing mathematical knowledge and understanding. It is important that children develop positive attitudes and interests in mathematics, 'have a go', communicate what they notice and not be afraid to make mistakes.</p> <p>Children learn to:</p> <p><b>Number</b></p> <ul style="list-style-type: none"> <li>• count verbally to 50 and beyond</li> <li>• count objects to 20, matching numerals to amounts</li> <li>• order, compare and estimate numbers to 12</li> </ul>

- identify and represent numbers using objects and pictorial representations including the number line, and use the language of: equal to, more than, less than (fewer), most, least
- read and write numbers from 1 to 20 in numerals and words.

**Addition and subtraction**

- read, write and interpret mathematical statements involving addition (+), subtraction (−) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20
- add and subtract one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as  $7 = ? - 9$ .

**Multiplication and division**

- solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.

**Fractions**

- recognise, find and name a half as one of two equal parts of an object, shape or quantity
- recognise, find and name a quarter as one of four equal parts of an object, shape or quantity.

**Measurement**

- subitise up to 5
- compose and decompose numbers to 10, including conceptual subitising, to support developing knowledge of number bonds to 10
- add, subtract and share in meaningful contexts, including number games and story contexts
- solve simple problems and communicate mathematical ideas using pictures, words and symbols

[no fractions]

- compare, describe and solve practical problems for:
  - lengths and heights [for example, long/short, longer/shorter, tall/short,
  - double/half]
  - mass/weight [for example, heavy/light, heavier than, lighter than]
  - capacity and volume [for example, full/empty, more than, less than, half, half full, quarter]
  - time [for example, quicker, slower, earlier, later]
- measure and begin to record the following:
  - lengths and heights
  - mass/weight
  - capacity and volume
  - time (hours, minutes, seconds)
- recognise and know the value of different denominations of coins and notes
- sequence events in chronological order using language [for example, before and after, next, first, today, yesterday, tomorrow, morning, afternoon and evening] recognise and use language relating to dates, including days of the week, weeks, months and years
- tell the time to the hour and half past the hour and draw the hands on a clock face to show these times.

#### **Geometry: Properties of shapes**

- recognise and name common 2-D and 3-D shapes, including:
- 2-D shapes [for example, rectangles (including squares), circles and triangles]
- 3-D shapes [for example, cuboids (including cubes), pyramids and spheres].

#### **Geometry: Position and direction**

#### **Measures**

- solve problems involving comparison of length, area, capacity and mass
- sequence events, involving times of day, days of the week and months of the year.

#### **Spatial reasoning**

- compose and decompose shapes to solve problems, and talk about shape properties
- plan mentally to build constructions including repeated units; solve shape puzzles, predicting which shapes will fit and how
- turn and flip objects and create reflections
- engage with 3D models & 2D maps of familiar environments, sequencing landmarks, and designing small worlds.

#### **Pattern**

- identify the unit of repeat in repeating patterns (e.g. ABC, ABBC) linking a range of media, music etc.
- recognise growing patterns in number, shape and size.

- describe position, direction and movement, including whole, half, quarter and three quarter turns.

## National Curriculum Year 2

### The issues

- Content needs to be based on research evidence for 6 to 7 year-olds, building on foundational concepts securely established in Year 1.
- The curriculum is not the same as assessment goals, and should identify an entitlement to experiences which ensure learning and positive attitudes.
- There needs to be more about pattern, spatial reasoning, problem solving and mathematical thinking, as in the Characteristics of Effective Learning, including attitudes and mathematical habits of mind. Children should feel able to approach any maths problem, thinking about the mathematical structure, manipulating the mathematics flexibly and sense-checking their ideas and solutions.
- The pedagogy should be less focused on seated, written work and more on discovering and communicating mathematical ideas. Mathematical communication should involve reasoning verbally and with manipulatives as well as drawing and a range of written approaches.
- The curriculum should be focussed on mathematical thinking in contextualised and abstract activities, problems and investigations.

### Recommendation

Current programme of study for Year 2	A programme of study based on research evidence
<p>Pupils should be taught to:</p> <p><b>Number and place value</b></p> <ul style="list-style-type: none"> <li>• count in steps of 2, 3, and 5 from 0, and in tens from any number, forward and backward</li> <li>• recognise the place value of each digit in a two-digit number (tens, ones)</li> <li>• identify, represent and estimate numbers using different representations, including the number line</li> <li>• compare and order numbers from 0 up to 100; use <math>&lt;</math>, <math>&gt;</math> and <math>=</math> signs</li> </ul>	<p>Children solve problems, using and applying mathematical knowledge and understanding. It is important that children develop positive attitudes and interests in mathematics, 'have a go', communicate what they notice and not be afraid to make mistakes.</p> <p>Children learn to:</p> <p><b>Number</b></p> <ul style="list-style-type: none"> <li>• compose and decompose numbers, including numbers bonds to 20, subtraction as taking away &amp; difference, and equations (including identifying structures from story problems)</li> </ul>



- read and write numbers to at least 100 in numerals and in words
- use place value and number facts to solve problems.

### Addition and subtraction

- solve problems with addition and subtraction:
  - using concrete objects and pictorial representations, including those involving numbers, quantities and measures
  - applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently, and derive and use
  - related facts up to 100
  - add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
    - a two-digit number and ones
    - a two-digit number and tens
    - two two-digit numbers
    - adding three one-digit numbers
- show that addition of two numbers can be done in any order (commutative) and
- subtraction of one number from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems

### Multiplication and division

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication ( $\times$ ), division ( $\div$ ) and equals (=) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot

- order, compare and estimate numbers to 100 and beyond, using number lines and hundred squares
- multiply using repeated addition, counting in units of 2s, 5s & 10s
- solve sharing and grouping problems

- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts

**Fractions**

- recognise, find, name and write fractions  $\frac{1}{3}$ ,  $\frac{1}{4}$ ,  $\frac{2}{4}$  and  $\frac{3}{4}$  of a length, shape, set of objects or quantity
- write simple fractions for example,  $\frac{1}{2}$  of 6 = 3 and recognise the equivalence of  $\frac{2}{4}$  and  $\frac{1}{2}$ .

**Measurement**

- choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); mass (kg/g); temperature ( $^{\circ}\text{C}$ ); capacity (litres/ml) to the nearest appropriate unit, using rulers, scales, thermometers and measuring vessels
- compare and order lengths, mass, volume/capacity and record the results using  $>$ ,  $<$  and  $=$
- recognise and use symbols for pounds (£) and pence (p); combine amounts to make a particular value
- find different combinations of coins that equal the same amounts of money
- solve simple problems in a practical context involving addition and subtraction of
- money of the same unit, including giving change
- compare and sequence intervals of time
- tell and write the time to five minutes, including quarter past/to the hour and draw the
- hands on a clock face to show these times
- know the number of minutes in an hour and the number of hours in a day.

[no fractions]

**Measures**

- solve problems involving comparison and order of length, area, volume, mass, money and time, beginning to use standard units alongside non-standard by exploring centimetre cubes, rulers, scales and timers
- sequence events, involving times of day, days of the week and months of the year, beginning to use analogue and digital clocks

**Geometry: Properties of shapes**

- identify and describe the properties of 2-D shapes, including the number of sides and line symmetry in a vertical line
- identify and describe the properties of 3-D shapes, including the number of edges, vertices and faces
- identify 2-D shapes on the surface of 3-D shapes, [for example, a circle on a cylinder and a triangle on a pyramid]
- compare and sort common 2-D and 3-D shapes and everyday objects.

**Geometry: Position and direction**

- order and arrange combinations of mathematical objects in patterns and sequences
- use mathematical vocabulary to describe position, direction and movement, including movement in a straight line and distinguishing between rotation as a turn and in terms of right angles for quarter, half and three-quarter turns (clockwise and anticlockwise).

**Spatial reasoning**

- compose and decompose shapes to solve problems, identify shapes using definitions and talk about shape properties using mathematical terms, informal language, gesture and analogies
- plan mentally and draw complex constructions including repeated units, staircases and ceilings
- solve shape puzzles of increasing complexity, predicting which shapes will fit and how; create own puzzles
- visualise transformations by sliding, reflecting and rotating objects,
- predict what and how things will appear from different viewpoints, including from above
- interpret and make 3D models and 2D maps of familiar environments, with symbols and relative distances, using these to navigate

**Pattern**

- create complex repeating patterns (e.g. ABC, ABBC) translating between a range of media, including music
- identify the rule in growing patterns in number and shape and in spatial patterns