**Must: Write at least two or three facts about Saint Peter.** Mathematics progression skills with reasoning - Power Maths

# Reception

## Early Learning Goal: Number and Number Patterns (including ideas to develop children's spatial reasoning skills) with suggestions

## ELG : NUMBER AND NUMBER PATTERN

**Number:** Children have a deep understanding of number to 10, including the composition of each number; - Subitise (recognise quantities without counting) up to 5; - automatically recall (without reference to rhymes, counting or other aids); number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts

**Numerical Pattern:** Children compare quantities up to 10 in different context, recognising when one quantity is greater than, less than or the same as the other quantity; verbally count beyond 20, recognising the pattern of the counting system; explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally.

Autumn: Units 1 -4

Spring: Units 6-10

Summer: Units 13 - 15

| **Counting: saying number words in sequence:**<br><br>• Sing number rhymes that encourages the children to count forward as well as backwards. | **Counting: tagging each object with one number word:**<br><br>• Provide children with opportunities to count things of different sizes – this helps children to focus | **Subitising: recognising small quantities without needing to count them all:**<br><br>• Use dot cards, dominoes and dice as part of a game, including irregularly arranged dots (e.g. stuck on) | **Numeral meanings:**<br><br>• Use numeral dice in games; matching numerals with varied groups of things<br>•Use 'tidy-up labels' on containers and checking that nothing is missing | **Conservation: knowing that the number does not change if things are rearranged (as long as none have been added or taken away** | **Comparison:** involves knowing which numbers are worth more or less than each other.<br>***More than / less than*:**<br>• Provide collections for children to sort and compare, which |
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| • Begin counting from different numbers.<br>• 'Washing line – children pin numbers forwards and backwards in a sequence<br>**(Remember that although counting back is a useful skill, the children might find this challenging due to the demand it places on their working memory)** | on the numerosity of the count<br>• counting things that can't be seen, such as sounds, actions, words<br>• counting things that cannot be moved, such as pictures on a screen, birds at the bird table, faces on a shape.<br><br>~~**Use of number:** Provide~~ opportunities for children to understand that numbers are used in many ways, some more mathematical than others E.g.<br>George has 5 dinosaurs ***(cardinal)***<br>Ava-Rose is ***fifth*** in the line today ***(ordinal)***<br>Numbers on or doors at home, telephone numbers, numbers on Arsenal players' shirt ***(nominal)***<br>**'**Come to our house at 5 p.m. on the September 5 ***(referential)*** | • 'Dice roll and match – children take turns to roll the dice they then select the corresponding amount of objects<br>• playing hidden object games where objects are revealed for a few seconds; for example, small toys hidden under bowl – shuffle them, lift the bowl briefly and ask how many there were<br>• 'all at once fingers' – show me four fingers……. | • Read number books<br>• Put the right number of snacks on a tray for the number of children shown on a card.<br>• 'Place signs for 2 wheels, 3 wheels and 4 wheels. When children 'park' their vehicles, they match their vehicle to the correct bay. | • Use of a puppet - correcting a puppet who may say that there are more or fewer objects now, as they have been moved around, e.g. spread out or pushed together<br>• Contexts such as sharing things out (grouping them in different ways) and then the puppet complaining that it is not fair as they have less<br>• Encourage the children to make different patterns with a given number of things. | include objects which are identical, and which include objects of different kinds or sizes<br>• Provide collections with a large number of things, and collections with a small number of things.<br><br>***Identifying groups with the same number of things:***<br>• Ensure that when providing groups to compare, there are some that have an equal amount<br>• Ask children to convert two unequal groups into two that have the same number, e.g. 'There are 6 apples in one bag and 2 in another bag; can we make the bags equal for the two hungry horses?'<br>***Comparing numbers and reasoning:***<br>• Explain unfair sharing - 'This one has more because it has 5 and that one only has 3'<br>• Compare numbers that are far apart, near to, and next to each other. |

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| | | | | | ***Knowing the 'one more than/one less than' relationship between counting numbers:***<br>• labelling groups with the correct numeral. Do children spot the error if a group is mislabelled? E.g. 'The label on the pot says 4 and we have 5 – what do we need to do?' A child may say, 'We need to take one out because we have one too many.'<br>• ensuring children focus on the numerosity of the group by having items in the collection of different kinds and sizes<br>• making predictions about what the outcome will be in stories, rhymes and songs if one is added to, or if one is taken away. |

Big Idea – Cardinality and counting: The cardinal value of a number refers to the quantity of things it represents, e.g. the numerosity, 'how many ness', or 'threeness' of three. When children understand the cardinality of numbers, they know what the numbers mean in terms of knowing how many things they refer to. Counting is one way of establishing how many things are in a group, because the last number you say tells you how many there are. Children enjoy learning the sequence of counting numbers long before they understand the cardinal values of the numbers. Subitising is another way of recognising how many there are, without counting.

| Common errors in this area may include: | What to look out for: |
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| • missing out an object or counting an object twice<br>• when asked how many cars are in a group of four, the child simply recount 1, 2, 3, 4, without concluding that there are four cars in the group.<br>• When asked to 'get five oranges' from the snack bowl, the child just grabs some, or carries on counting past five.<br>• when objects in a group are rearranged, the child (unnecessarily) recounts them to find how many there are.<br>• difficulties in counting back<br>• confusion over the teen numbers - they are hard to learn.<br>• missing a number like 15 (13 or 15 are commonly missed out) or confusing 'thirteen' with 'thirty'. | ***Can the children:***<br>• consistently recite the correct sequence of numbers and cross decade boundaries?<br>• collect nine from a large pile, e.g. nine pencils from a pot?<br>• subitise (instantly recognise) a group that contains up to four, then five, in a range of ways, e.g. fingers, dice, random arrangement?<br>• select a numeral to represent a quantity in a range of fonts, e.g. 4, 4, 4, 4?<br>• correct a puppet who thinks the amount has changed when their collection has been rearranged? |

# ADDITION AND SUBTRACTION

Children compare quantities up to 10 in different context, recognising when one quantity is greater than, less than or the same as the other quantity

Autumn: Units 2 and 4

Spring: Units 8 and 9

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| **Counting: knowing the last number counted gives the total so far:**<br>• Play dice games to collect a number of things<br>• Play track games and counting along the track….<br><br>***Comparison:***<br>'I have a handful of raisin; Matthew has a bowlful. Matthew has more!'<br><br>'I have 1 pear and 1 banana; you have 2 apples. We have the same number of fruits'. | **Part–whole: identifying smaller numbers within a number (conceptual subitising – seeing groups and combining to a total):**<br>• Encourage making arrangements with (e.g.) ten; ensuring the children talk about the different arrangements they can see within the whole. | **A number can be partitioned into different pairs of numbers:**<br>• Numicon towers: layering up Numicon pieces of the same total<br>• Put things into two containers in different ways ***'You had 12 oranges and you gave your friend 5. How many do you have now?***<br>• Make a number with two different kinds of things. E.g. make a fruit skewer with five pieces of fruit, using bowls of bananas/strawberries to | **A number can be partitioned into more than two numbers:**<br>• Role play, e.g. in a toy shop, ten toys need arranging onto the three shelves. How will you organise them?<br>• Have more than two places to sort things into in any given context, e.g. arranging characters in small-world play in different locations<br><br>• Games such as 'Posh Ducks' (Griffiths, R., Back, J. | **Inverse operations:**<br>• Explore songs; for example, 'Five Currant Buns' – show that the whole is still five, but some are in the shop and some have been taken away; check throughout that there are still five currant buns<br>• Play skittles and looking at how many are standing. How many have fallen over? How many are there altogether?<br>• During physical play, '***You have 2 balls and I have 3 balls how many balls do we*** | **Number bonds: knowing which pairs make a given number:**<br>• Play hiding games with a number of objects in a box, under a cloth, in a tent, in a cave, etc.<br>• Utilise classroom routines such as tidy-up time to identify how many are still missing from a pot with a number label. |

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| 'Rose has 3 dirty plates and Joshua has 4 dirty bowls. Who has fewer dishes to wash'? | | choose from; then ask the children to describe how they have made theirs. They should compare it with a partner's: 'What is the same about your skewers? What is different?'<br>• Play Bunny Ears: using your fingers like bunny ears. 'With two hands, show me five fingers. How many different ways can you show 5 fingers on both hands'? Or, 'Show five fingers altogether with a friend.'<br>• Play spill the Beans: using double-sided counters or beans, where one side is coloured, throw the collection and note how many of each type can be seen and how many altogether.<br>• Use six bean bags with different fabric on each side, throw the collection and note how many of each type can be seen. | & Gifford, S. (2016) Making Numbers: Using manipulatives to teach arithmetic, OUP): using a set number of ducks, for example ten in three different locations (nest, water, decking), roll the dice and make one group match the amount shown without adding or taking any away. | ***have altogether? If three balls rolled away how many balls would we have left'?*** | |

Big Idea – Composition and decomposition: Children need opportunities to develop their understanding that sets can be changed by adding items (joining) or by taking away (separating), that sets can be compared using the attribute of numerosity and ordered by more than, less than and equal to, that a quantity (whole) can be decomposed into equal or unequal parts and that the parts can be composed to form the whole. Knowing numbers are made up of two or more other smaller numbers involves 'part-whole' understanding. Learning to 'see' a whole number and its parts at the same time is a key development in children's number understanding. Partitioning numbers into other numbers and putting them back together again underpins understanding of addition and subtraction as inverse operations.

| **Common errors in this area may include:** | **What to look out for:** |
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| • children suggesting that a larger number than the total are hidden. | ***Can the children:*** |

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| | • subitise smaller groups within a larger group?<br>• make a reasonable guess at a hidden number after seeing the whole or a part?<br>• in context, state two groups that make a larger amount. E.g. how might the six bean bags land? Child responds: you could have 3 with the stripes up and 3 with the spots up. |

# PROBLEM SOLVING - EXPLORING AND REPRESENTING

Children explore and represent patterns within numbers up to 10, including evens and odds, double facts and how quantities can be distributed equally.

Summer: Unit 15

| **Playing and exploring** | **Active Learning:** ***provide a rich context such as a carefully-chosen, inviting set of resources that offer lots of freedom to play, explore, question and try out ideas. The resources themselves may not be regarded as inherently mathematical.*** | **Creating and thinking critically** |
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| Make butterflies and stick dots or craft pom-poms in ones, twos and fours on each wing. Encourage the children to think about where to place the dots/pom-poms<br>• Use NumberBlocks Series 2 Episode 9 (see https://www.ncetm.org.uk/resources/52060 for supporting materials)<br>• Play doubling and halving games with their feet and hands. What do they notice?<br>• Use five and ten frames with double sided counters<br>• Use NRich Packing, Collecting, tidying and Baskets games to develop problem solving | • Notice how children doubling in their play e.g. if another child comes to join them when they ae playing alone.<br>• Use NumberBlocks Series 2 Episode 9 (see https://www.ncetm.org.uk/resources/52060 for supporting materials) | • Use NumberBlocks Series 2 Episode 9 (see https://www.ncetm.org.uk/resources/52060 for supporting materials)<br>• Use a six-faced dice labeled with the dice patterns for 1, 2, and 4 (each number appear twice), encourage the children to make up a game that involves finding doubles when rolling the dice. Provide equipment and resources such as empty number tracks, empty 10x10 grids, empty jars and craft pom-poms or counters. Notice the language that the children use when designing and playing the game. |

Big Idea - Problem Solving: EYFS children are natural problem solvers. They attain their goals by mimicking others, trying things out, making lots of mistakes, adjusting their strategies accordingly and gradually gaining confidence. For authentic problem solving to take place, there must be an authentic problem - one whose solution is not obvious or predetermined. To nurture, support and further develop problem solving in EYFS, adults need to provide a rich context (with appropriate resources and skilful questioning), provide a 'think follow, support, question stimulating thinking' approach and repeatedly providing children with opportunities to develop key problem-solving skills.

| **Adults need to ensure that:** | **What to look out for:** |
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| • children can freely explore to allow them to propose solutions<br>• children are given multiple ways to make sense of problem situations e.g. How many? – by acting it out, making drawings or using manipulatives. | ***Can the children:***<br>• spot patterns and relationships? |

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| • children are given lots of experiences thinking through how relationships between quantities work in real life.<br>• they keep number operations firmly grounded in mathematical problem situations involving the ***changes, comparisons and part/whole relationships.*** | • describe and compare different mathematical aspects of different contexts?<br>• explain why a mathematical answer is true?<br>• Predict what might happen or ask questions to help them visualise a mathematical context?<br>• draw/mark make/symbols to explain their thinking?<br>• recognise that doubling is adding the same number to itself?<br>• recognise that halving is sharing into two equal portions? |

# DEVELOPING CHILDREN'S SPATIAL REASONING SKILLS

In addition to Autumn: Unit 5, Spring: Unit 11 and Summer: Unit 14

See below for the coverage the various areas in this strand.

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| **Recognising attributes:**<br><br>• ensuring adults model language which highlights the specific attribute that is the focus of attention<br><br>• dough modelling, which can provide a good opportunity to discuss the length of snakes, or the weight of different-sized lumps<br><br>• water and sand-play, which can provide lots of opportunities to highlight capacity.<br><br>(Also see **ELG 12: SHAPE, SPACE AND MEASURES- MATHEMATICAL LANGUAGE** for suggestions) | **Comparing amounts of continuous quantities:**<br><br>• encouraging children to compare different attributes in everyday situations: 'I wonder who has the longest snake?' 'I wonder whose pot will hold the most water?' 'I wonder which ball is the heaviest?'<br><br>• cutting a piece of ribbon as long as a child's arm and encouraging them to find things in the environment that are longer, shorter or the same length<br><br>• focusing on asking for specific things according to their attributes. For example: 'Please can you pass me a ... that is ... than this one?'<br><br>• when comparing directly, finding the odd one out, by providing a | **Showing awareness of comparison in estimating and predicting:**<br><br>• making a bed for a teddy using blocks<br><br>• selecting a box or container to store a specific item<br><br>• dressing dolls, and selecting different-sized clothes<br><br>• finding things that will fit inside a matchbox.<br><br>**Comparing indirectly:**<br><br>• making 'Russian doll'-type sets of nesting boxes from a collection | **Recognising the relationship between the size and number of units:**<br><br>• set up an Estimation Station and guessing how many things are in the jar each day<br><br>• making biscuits from a given amount of dough – choosing cutters to see who will make the most biscuits<br><br>• choosing from a selection of spoons, ladles, etc, to see who can fill their pot the quickest<br><br>**Beginning to use units to compare things:**<br><br>• setting up a 'filling station' with lots of different-sized containers to | **Beginning to use time to sequence events:**<br><br>• un-muddling visual timetables<br><br>• making picture sequences for cooking instructions<br><br>• describing sequences by re-telling stories<br><br>• discussing 'o'clock' times at registration, lunchtime, snack time, tidy-up time, etc.<br><br>• making their own timetable for a day – selecting activities and ordering them.<br><br>**Beginning to experience specific time durations:** |

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| | varied range of container shapes all containing the same amount of liquid except for one. 'Which one do you think is the odd one out? Why? How will we check? Were we right?'<br><br>• posing see-saw problems, relating to weight: 'What can we do to make this side of the see-saw go down?'<br><br>• using a simple spring balance to compare the weight of cargo for a toy boat<br><br>• setting up a 'balancing station' with interesting things to weigh and to balance, indoors and outdoors<br><br>• comparing different parcels, ensuring some of the smaller parcels are heavy, and some of the larger parcels are light.<br><br>(Also see **OLD ELG 12: SHAPE, SPACE AND MEASURES- MATHEMATICAL LANGUAGE** for suggestions) | • finding ways of seeing if the cupboard or carpet will fit in the role-play area without moving it<br><br>• finding which of three pairs of shoes is heaviest for packing in a rucksack<br><br>• packing a shopping bag, making sure the lightest items do not get squashed by heavier things. | fill with beads, then comparing capacities<br><br>• using large bricks to measure the height of individuals<br><br>• using metre sticks to see if an elephant or dinosaur would fit in the room<br><br>• measuring the growth of a beanstalk or sunflower with interlocking centimetre cubes<br><br>• comparing the capacity of different bottles by filling lots of glasses. | • events on a class calendar to count down to<br><br>• timers provided for children to set and respond to challenges; e.g. 'I wonder if we can run as fast as a cheetah', 'I wonder how many hops I can do in ten seconds', 'I wonder how many times I can write my name in a minute', etc.<br><br>• time durations with songs or music. |
| Big Idea – Measures: Mathematically, measuring is based on the idea of using numbers of units in order to compare attributes, such as length or capacity. Children need to realise which attribute is being measured, e.g. weight as opposed to size, and the idea of conservation: that the amount stays the same, even if the appearance alters, e.g. if dough is stretched out or in bits. Finally, children need to understand how equal size units are used repeatedly to express an amount as a number. While young children can engage actively in making comparisons and exploring equivalence of length, volume, capacity and weight in different ways, some of these ideas are challenging and will develop later in primary school. Measuring with non-standard units of different sizes in order to appreciate the need for equal | | | | |

units is less effective with younger children, so centimetre cubes are recommended as accessible units. While time is also elusive to measure, young children can sequence events and, for example, count 'sleeps'.

**Common errors in this area may include:**

- keeping track of events, e.g. 'Have I had my lunch yet?'
- positional language associated with time; muddling the relative terms 'yesterday' and 'tomorrow'
- using 'long' to describe the shape of something (e.g. a block that is much longer than it is wide) rather than to compare lengths
- not taking into account both ends as the starting and stopping point
- not being able to say 'than' in the phrase, 'this is longer than that'
- not understanding that units must cover a complete length, with no gaps or overlaps, demonstrated by thinking that measuring is about counting units placed along something, or putting a ruler alongside and saying a number
- not understanding that units must be equal.

**What to look out for:**

***Can the children:***

- find something that is longer, shorter, heavier, lighter (etc.) than a reference item?
- find an appropriate container for a specific item?
- describe the location of something using positional language?
- accurately use the relative terms 'yesterday' and 'tomorrow'?
- order a short sequence of events?

# DEVELOPING CHILDREN'S SPATIAL REASONING SKILLS - MATHEMATICAL LANGUAGE

| **Developing spatial and directional vocabulary-** *children need opportunities to be exposed to and to use the language of position and direction:* | **Developing comparative vocabulary -** *children need opportunities to be exposed to and to use the language of comparison:* | **Developing ordinal vocabulary -** *children need opportunities to be exposed to and use different ways of describing order and sequence:* | **Developing shape vocabulary** - *children need opportunities to be exposed to and use different ways of describing various shapes:* | **Developing calculation vocabulary -** *children need opportunities to be exposed to and to use the language of calculation* | **Developing time vocabulary –** *children need opportunities to be exposed to and use different ways of describing time* |
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| • hunting for hidden objects, with some prompts, e.g. 'Look behind the bicycle store, take three steps from the front of the art cupboard…' | • comparing weight by handling objects | • lining up objects such as small cars, farm animals and counters. | • What's in my bag shape game – use correct vocabulary to describe a shape children guess what shape it is | *• stories as a prompt for creating representations, e.g. how many animals wanted to eat The Gingerbread Man using First, then, next now* | • Using a calendar to mark events and a group diary to record happenings |
| • developing and talking about small-world scenarios, | • comparing height or speed through outdoor climbing or running activities | *Useful vocabulary:* ***first, last, second, third, in front of, end, beginning, before, after*** | • make shape monsters with partner – one child uses correct vocabulary to describe the shapes that | (Also see Addition and subtraction and Problem Solving for activities) | • Using how many days to talk about how many 'sleeps' till your birthday, Christmas, half term etc. |
| | • comparing length or distance between objects | | | | • Utilise classroom routines such as registration to talk |
| | *Useful vocabulary:* | | | | |

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| e.g. doll's house, miniature village, play park<br>• acting out their own versions of well-known stories where characters negotiate routes and obstacles, for example 'We're Going on a Bear Hunt'<br>• directing each other as robots.<br>• Any outdoor activity uses directional words especially if using wheeled vehicles or programmable toys.<br><br>(Also see Problem Solving and **Representing spatial relationships under OLD ELG 12: SHAPE, SPACE AND MEASURES- EXPLORING** for suggestions) | ***small and large, tall and short, fast and slow, heavy and light, hot and cold, high and low, near and far, young and old*** | (Also see Problem Solving for suggestions) | make up their monster and their partner draws it.<br>• use correct vocabulary to describe a shapes that make up different objects<br><br>*Useful vocabulary:*<br>***round, curved, wavy, straight, sloping, corners, pointed, sides, flat, circle, square, triangle*** | *Useful vocabulary:*<br>***more, less, the same, many, lots, fewer, greater than, more than, less than*** | about yesterday, today, tomorrow<br>• Sing 'days of the week' song<br><br>*Useful vocabulary:*<br>***today, tomorrow, yesterday, morning, afternoon, night, the days of the week*** |

Big Idea – Vocabulary: Children's mathematical vocabulary is enhanced when the adults who are working alongside them repeat key words in context during play activities, model using new words in commentary, encourage children to use new words through open-ended questioning and invite children to describe what they see, hear or think. Play situations provide a context for using maths vocabulary that makes sense to a child and helps understanding. Many traditional songs, finger plays and rhymes contain themes that focus on maths vocabulary. Children with English as an additional language or those with language delay will benefit from pictures, models and pantomime to accompany the songs. Children need to be given time to fully explore the activities they are involved in and not be rushed to finish, nor should the focus to be on the finished product.

| **Common errors in this area may include:** | **What to look out for:** |
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| • mistaking a circle for an oval when identifying a shape<br>• mistaking a square for a rectangle when identifying a shape | ***Can the children:***<br>• use the correct mathematical language to describe various shapes?<br>• Differentiate shapes with same/similar properties? |

# DEVELOPING CHILDREN'S SPATIAL REASONING SKILLS - EXPLORING

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| **Developing spatial awareness- experiencing different viewpoints**<br>*Children need opportunities to move both themselves and objects around, so they see things from different perspectives. This will support them in visualising how things will appear when turned around and imagining how things might fit together:*<br>• riding trikes around interesting routes<br>• construction activities<br>• printing and making pictures and patterns with shapes<br>• posting boxes<br>• jigsaws<br>• making a complete circuit with a train track<br>• directing a simple robot or remote-controlled toy vehicle along a route<br>• tangrams: 'Can you make a person with the shapes?'<br>• with toys in a line: 'Can you say what the teddy on the other side is seeing?' | **Shape awareness - developing shape awareness through construction.** *Through play – particularly in construction – children have lots of opportunities to explore shapes, the attributes of particular shapes, and to select shapes to fulfil a particular need.*<br><br>• construction with structured and unstructured materials<br>• making dens with varied materials outdoors. | **Developing an awareness of relationships between shapes-**<br>*As children become more confident with specific shapes, encourage them to spot shapes within shapes:*<br>• choosing 2D shapes to construct a 3D model, e.g. using triangles and rectangles to make a tent<br>• making decorations by folding and cutting<br>• making 3D shapes using interlocking shapes. | **Representing spatial relationships.** *Small world play and model building provide lots of opportunities for children to describe things being 'in front of', 'behind', 'on top of' etc., and to consider objects from different perspectives:*<br><br>• designing a plan for a garden or play area, using a small tray with sand, twigs, building bricks, etc<br>• drawing or making a simple map of a route with 'landmarks', e.g. houses and trees<br>• following a simple map of an excursion. | **Identifying similarities between shapes -**<br>*Children need opportunities to construct and create things that represent objects in their environment. As they do this, they should notice shape properties of the object that they want to represent:*<br><br>• *stories as a prompt for creating representations, e.g. building a house for the three bears*<br>• *making pictures with found materials, as well as structured shapes and blocks.*<br><br>**Describing properties of shape:**<br><br>• covering objects in foil and inviting children to justify their guesses about what is inside<br>• making arrangements with a selection of different rectangles, including squares. | **Showing awareness of properties of shape:**<br>• making an insect hotel – selecting tube-like shapes from a collection of varied materials, some not fit for purpose<br>• creating an extended channel for water to flow from a high container to a low one, some distance away<br>• asking questions, for example: 'What shapes can you make with three people inside a loop of string? What about with four people?' 'What is the same and what is different about these?'<br>• making shapes with sticks and with their own bodies<br>• printing with shapes: 'What footprint do you think this cylinder will make? What about if you roll it?' |

Big Idea – Shape and Space: Mathematically, the areas of shape and space are about developing visualising skills and understanding relationships, such as the effects of movement and combining shapes together, rather than just knowing vocabulary. Spatial skills are important for understanding other areas of maths and children need structured experiences to ensure they develop these. Children begin to recognise that relationships between objects and places can be described with mathematical precision, that spatial relationships can be visualised and manipulated mentally and that our own experiences of space and wo dimensional representations of space reflect a specific point of view. They also understand that shapes can be defined by their attributes, that the flat faces of solid (three-dimensional) shapes are two-dimensional shapes and that shapes can be combined and separated |(composed and decomposed) to make new shapes. Opportunities should encourage children to actively explore spatial relations and the properties of shapes, in order to develop mathematical thinking (rather than on shape classification, which requires prior knowledge of properties).

**Common errors in this area may include:**

- children thinking that only regular triangles are triangles, only brick-like rectangles are rectangles (i.e. shapes are defined by their image, not by their properties)
- children thinking that squares are only squares when the bottom is horizontal (i.e. shapes are defined by their orientation).

**What to look out for:**

***Can the children:***

- select and rotate shapes to fit into a given space?
- use positional vocabulary, including relative terms, to describe where things are in small-world play?
- show intentionality in selecting shapes for a purpose, such as cylinders to roll?
- make a range of constructions, including enclosures, and talk about the decisions they have made?
- see shapes in different orientations and recognise that they are still that shape?
- recognise a range of triangles and say how they know what they are?

# DEVELOPING CHILDREN'S SPATIAL REASONING SKILLS – PATTERNS

| **Pattern-spotting around us:** | **Continuing an AB pattern -** | **Copying an AB pattern** | **Make their own AB pattern:** | **Spotting an error in an AB pattern:** | **Continuing an ABC pattern:** |
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| • exploring patterns in stories, songs and rhymes<br>• where possible, representing these diagrammatically to support pattern-spotting, and | *Children need the opportunity to see a pattern, to talk about what they can see, and to continue a pattern. At first, they will do this one item at a time, e.g. red cube, blue cube, red* | • accessing a range of patterns to copy. For example, using the plastic bears: big, small, big, small, big…<br>footwear: shoe, welly, shoe, welly…, | • challenging children to change one element of the pattern they have created, e.g. 'Can you change the red bear to a blue bear? What is the pattern now?' | • presenting patterns with deliberate errors, including extra, missing and swapped items, e.g. red cube, blue cube, red cube, blue cube, red cube, red cube, blue | • building towers or trains of different-coloured cubes (continuing patterns horizontally and vertically)<br>• extending patterns using a wide range of identical objects in different colours, |

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| predicting what will happen next, and why<br>• inviting children to spot patterns in the home environment, or bring in examples from home<br>• looking at fabric patterns from different cultural traditions: discussing the patterns in terms of what stays the same and what is different<br>• designing wrapping paper for a specific event that involves creating a pattern which the children can describe.<br><br>**Symbolising the unit structure:**<br>• including the following phrasing in discussion and dialogue: 'This is a red blue pattern; this/that; I call it an A (one of these) then a B (one of those).'<br>• constructing patterns with actions and developing symbols to show the pattern and to provide 'instructions' for someone else to follow the pattern<br>• inviting friends to copy the pattern from the symbols.<br><br>**Generalising structures to another context or mode:**<br><br>• providing a range of experiences where children | *cube…verbalising the pattern helps*.<br>• building towers or trains of different-coloured cubes (continuing patterns horizontally and vertically)<br>• extending patterns using a wide range of identical objects in different colours, e.g. beads; small plastic toys such as bears, dinosaurs, vehicles. Try to avoid interlocking cubes or bead-threading so children can focus on the pattern rather than their coordination skills. | actions and sounds: jump, twirl, jump, twirl, jump… or clap, stamp, clap, stamp…<br>• collecting things in the outdoors environment: leaf, stick, leaf, stick…<br><br>**Making a pattern which repeats around a circle**<br>• making circular patterns such as necklaces, circles of linking elephants or camels<br>• using pre-given circles to create a border, such as on or around a paper plate<br>• exploring which patterns work, which don't, and why<br>• offering a unit of the pattern and asking the child if they can include it in their pattern<br>• making patterns around rectangular or other shaped frames.<br><br>**Making a pattern around a border with a fixed number of spaces:**<br>• creating borders around defined spaces in the learning environment, i.e. a garden for the teddy bears, an outdoor reading area, etc.<br>• encouraging children to predict if the pattern could 'keep going', voting on this and discussing their thoughts and reasons with a partner. | • ensuring that there are numerous opportunities to create patterns – e.g. in the outdoors, using natural materials such as sticks, leaves, stones, pine cones; in craft activities, using stamping, sticking, printing; with musical instruments, using sounds such as drums, shakers, triangles, etc.<br>• working collaboratively with a friend to take turns to create a pattern, e.g. one claps, one stamps, or one gets the red bear, one gets the yellow bear, etc.<br>• challenging a friend to continue or copy their pattern. | cube – identifying there is an extra item and fixing it by removing the extra red cube, putting in an extra blue cube, or swapping the final cubes<br>• asking the children to make a pattern with a deliberate mistake and challenging a friend to spot it.<br><br>**Identifying the unit of repeat:**<br>• highlight within a pattern what the unit of repeat is and ask the children to describe it. At this point for pattern novices (children who aren't as experienced as others), it would be good to do this with physical objects so that the unit of repeat can be moved to show how it repeats. Patterns that are printed, stamped or stuck down, and therefore cannot be corrected, are | e.g. beads; small plastic toys such as bears, dinosaurs and vehicles.<br>**N.B. Try to avoid using interlocking cubes or bead-threading, so children can focus on the pattern they are constructing rather than on their coordination skills.**<br>**Continuing a pattern which ends mid-unit:**<br>• providing a range of patterns – physical and on cards – that children can continue<br>• ensuring that the patterns offered have different structures and end after a complete or a partial unit.<br><br>~~**Make their own ABB, ABBC patterns:**~~<br>• utilising a range of items in the environment to create patterns such as interlocking cubes and toys, e.g. links, elephants, camels<br>• exploring and creating patterns on peg boards, with fruit (e.g. fruit kebabs), musical<br>**Spotting an error in an ABB pattern:**<br>• presenting patterns with deliberate errors<br>• once children have fixed the pattern, encouraging them to check the 'fix' by tracking the pattern<br>• asking the children to make a pattern with a |

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| can create a pattern using a coding structure<br>• ensuring children can follow the patterns they have coded. | | | | | deliberate mistake and challenging a friend to spot it. |

Big Idea – Patterns: Developing an awareness of pattern helps young children to notice and understand mathematical relationships. Seeking and exploring patterns is at the heart of mathematics (Schoenfeld, 1992). Clements and Sarama (2007) identify that patterns may provide the foundations of algebraic thinking, since they provide the opportunity for young children to observe and verbalise generalisations. Children need to recognise and understand that patterns are sequences (repeating or growing) governed by a rule; they exist both in the world and in mathematics, that identifying the rule of a pattern brings predictability and allows us to make generalisations and that the same pattern can be found in many different forms.

**Common errors in this area may include:**

- not recognising a pattern such as ABBA (e.g. stating that patterns cannot have two of the same colour together)
- when copying or extending a pattern, changing it before making three repeats
- spotting that there is an error but not being able to describe it
- identifying an error but not being able to correct it
- correcting an error by making a 'local correction', which just moves the problem along (e.g. by adding an extra item when colours have been swapped)
- describing the whole pattern instead of identifying the part which repeats, or the unit of repeat.

**What to look out for:**

***Can the children:***

- continue, copy and create an AB pattern?
- identify the pattern rule (unit of repeat) in an AB pattern?
- continue, copy and create ABB, ABBC (etc.) patterns?
- identify the pattern rule (unit of repeat) in ABB, ABBC (etc.) patterns?
- spot an error and 'correct' a pattern?
- explain whether a circular pattern is continuous or not?