

EARLY CHILDHOOD  
MATHS GROUP



# Outdoor Maths Matters



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Why early maths matters:

Those who start behind stay behind - and the gap widens in primary school.

Education Endowment Foundation (2020)

Mathematical achievement is consistently found to be the strongest predictor of children's overall school achievement and their success in entering the workforce.

Early Intervention Foundation (2018)

# What research tells us: Mathematical predictors

- parents' education and home learning EIF, 2018
- self-belief OECD, 2012
- mathematical reasoning Nunes & Bryant, 2012
- **number sense** Nunes & Bryant, 2009; EIF, 2018
- **patterning** Rittle-Johnson et al., 2016
- **spatial reasoning** Hawes & Ansari, 2020



Simon Lewis

# EYFS Statutory Mathematics Educational Programme

*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.***

EYFS Statutory Framework 2021

# Number predictors for 5 year olds



*Give me 9*



- **counting out** a number from a larger group
- **understanding cardinal numerals** (ie. a number of things)
- **understanding the order of numerals**



*When might children  
learn each of these?*

# How do young children learn number sense?

- **routines** – snack time, tidying up, visual time table
- **number rhymes and picture books**
- **games** – collecting, tracks, targets
- **problem solving** eg sharing
- **adult playfulness**- eg deliberate mistakes
- **‘sustained shared thinking’** (REPEY, 2002)



# The beginnings of pattern awareness

What makes it pattern?  
Which bits are the same?



Reflecting  
and rotating



Growing  
patterns



*Can you spot the  
mistake?*

# The importance of early patterning



We found that early patterning..knowledge was a unique predictor of later mathematics achievement, over and above other mathematics and non-math skills.

Rittle-Johnson et al. (2016, 2019)



Image: Eastwood Forest School

Abstracting patterns is the basis of structural knowledge,  
the goal of mathematics learning.

Warren (2005)



# Identifying the unit of repeat: beyond AB patterns



# Spatial reasoning involves



fitting things in



Image: Mr Leonard

navigation



St  
tion  
ass

understanding diagrams



Image: community playthings

construction and design



classification & identification

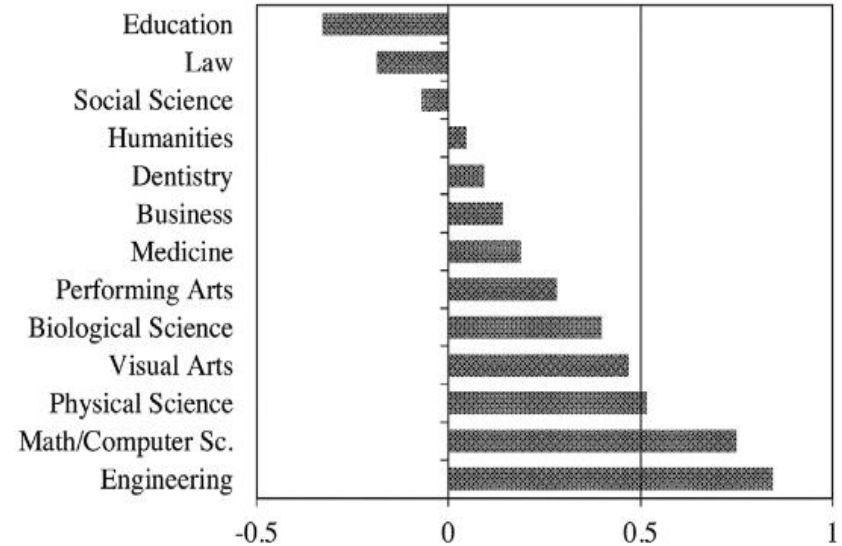


performing arts

# The importance of spatial reasoning

People who are good at maths tend to be good at visualising

Hawes & Ansari (2020)



Teaching spatial thinking may be an underutilized route to improving mathematics achievement.

Verdine et al. (2017)

Girls and other underrepresented groups are harmed in their progression in mathematics due to lack of attention to spatial skills.

Sarama & Clements (2009)



Image: Community Playthings

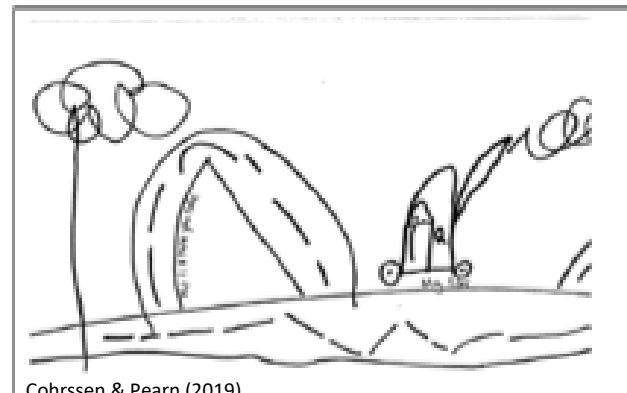


## Spatial relations

*Where is it?*  
*Which way?*

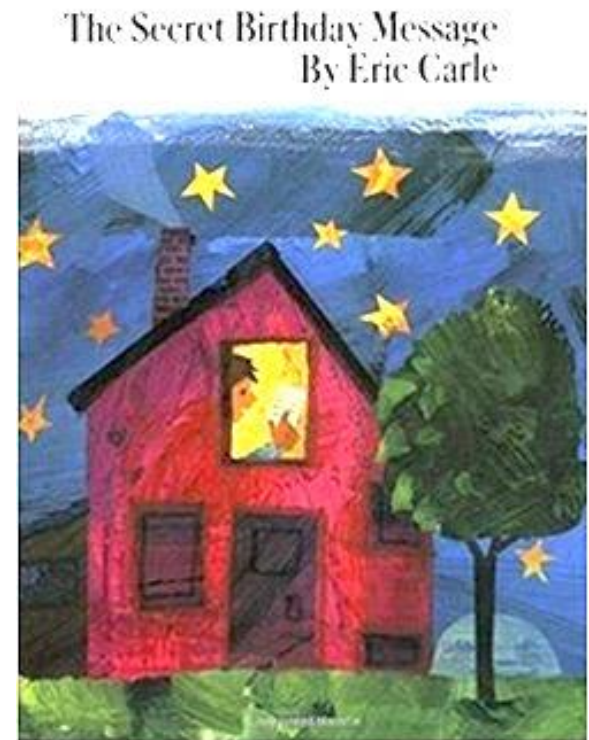


Mulligan et al 2020



Cohrsen & Pearn (2019)

- obstacle courses
- small world play
- route finding
- robots
- treasure hunts
- picture books
- models & maps



# The characteristics of effective teaching and learning

In planning and guiding what children learn, practitioners must reflect on the different rates at which children are developing and adjust their practice appropriately. Three characteristics of effective teaching and learning are:

- **playing and exploring** – children investigate and experience things, and ‘have a go’
- **active learning** – children concentrate and keep on trying if they encounter difficulties, and enjoy achievements
- **creating and thinking critically** – children have and develop their own ideas, make links between ideas, and develop strategies for doing things

Statutory framework for the EYFS



*More than ever before, living and working in the 21st century requires the “four Cs”  
– creativity, critical thinking, communication and collaboration*                      OECD 2016

# Maths Outdoors

- Puddle Jumping- counting/ size/ depth/ patterns



# Maths Outdoors

- Stones Stacks- ordering/ counting/ weights/space



# Maths Outdoors

- Leaf Patterns- ABAB/ size/ shapes





# Maths Outdoors

- Stick Collecting- size/subitising/ordering/shapes/measuring



# Maths Outdoors

- Water/Potion Play- capacity/ more or less/ language



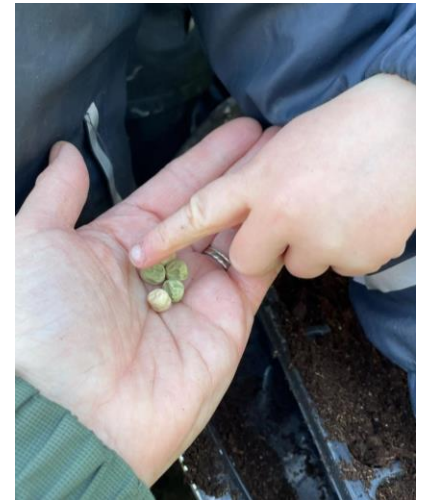
# Maths Outdoors

- Loose Parts- counting/cardinality/subitizing  
/number matching/ordering/ estimating



# Maths Outdoors

- Planting- counting/ estimating/ measuring/ size



# Maths Outdoors

- Obstacle Course- positional/ directional language / route planning/sequence



# Maths Outdoors

- Bug Hunting- counting/ positional/ directional I  
language/ size/ longer  
shorter/ bigger  
smaller/ massive  
tiny



# Maths Outdoors

- Mud Kitchen- weight/ measure/ more or less/ count/ sort/ comparison/ money/ capacity/ language

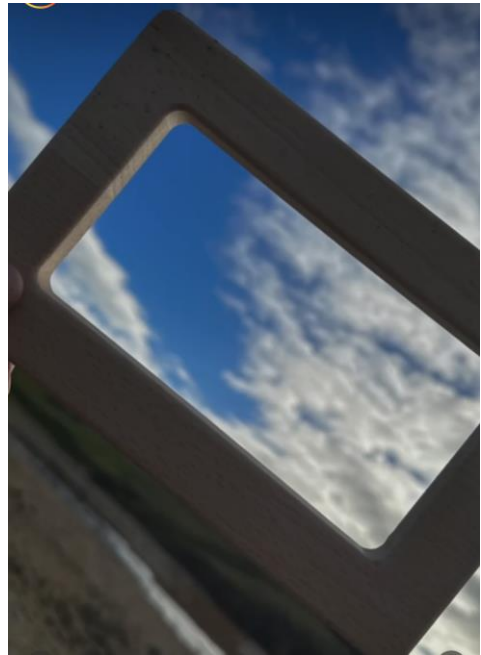


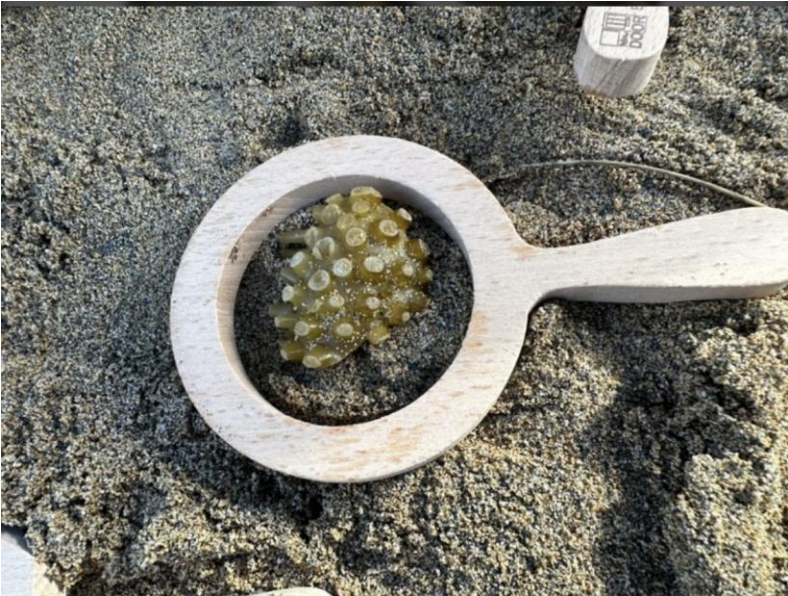
# Maths Outdoors

- Hopscotch with chalk- number recognition/ ordinal numbers/ matching quantity to number







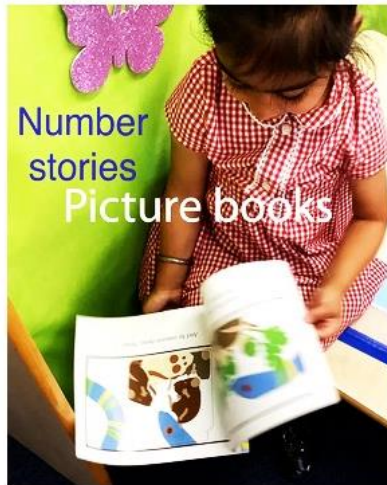




# earlymaths.org: guidance and resources



[HOME](#) [ABOUT ECMG](#) [LINKS & GUIDANCE](#) [OUR EXPERT OPINION](#)



# Practice guidance for different age groups



[HOME](#) [ABOUT ECMG](#) [RECOMMENDED LINKS](#) [OUR EXPERT OPINION](#) [🔍](#)

## Building firm foundations in mathematics



The Early Childhood Mathematics Group would like to offer some support and encouragement to all adults in helping children to become confident young mathematicians. We all know that maths is very important for young children's lives and their future life options. If we can help them build firm mathematical foundations, we will have given them a really good start. It is also important that families and practitioners work together to support children's mathematical learning.

Everyday experiences and routines, rhymes and games provide excellent mathematical learning opportunities for children under seven. Opportunities for mathematical learning can happen anywhere and should be practical wherever possible. What matters is building young children's confidence and their willingness to have a go, whether at counting, construction or shape puzzles. Since supportive relationships are so important, it is imperative to find activities that not only children enjoy, but that adults can enjoy too. Recognising the maths in everyday activities helps to develop children's mathematical learning even further. When playing and in everyday routines, such as having a snack, children can learn lots of maths.

### Download the guidance

[Babies to 2 year olds guidance](#) [Download](#)

[3, 4 & 5 year olds guidance](#) [Download](#)

[5, 6 & 7 year olds guidance](#) [Download](#)

# Spatial Reasoning Toolkit: trajectories, posters and key rings



## 3-4 years Spatial Reasoning Toolkit

At this age children are developing understanding of aspects of shape and space including composition (how shapes fit together), movements like turning and flipping, symmetry and scale. Children are beginning to recognise and predict familiar routes (e.g. to the park).



next to,  
turn, corner,  
pointy, curved,  
straight

### Puzzles

Moving, turning and predicting how pieces will fit



under, up,  
down, over,  
upside down

### Books

Using spatial language



through,  
over, around,  
under

### Obstacle courses

Experiencing and talking about directions



in front of,  
sideways,  
bigger,  
smaller

### Small world play

Understanding position and direction



straight, bend,  
corner, across,  
in front of,  
after, long way,  
smaller

### Out and about

Remembering and predicting routes, landmarks and directions, discussing perspectives and distance



same on  
both sides,  
reflection,  
pattern

### Pattern making and spotting

Arranging objects to make spatial patterns (position), noticing spatial patterns including symmetry in everyday objects



together, next  
to, slanting,  
pointy, curved,  
corner

### Block play

Using size and shape relationships as well as parts and whole to select blocks for specific purposes/structures



<https://doi.org/10.21203/rs.3.rs-1011111/v1>  
<https://www.earlychildhoodmaths.org.au/>  
@EarlyChildhoodMaths











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## Movement and Navigation Spatial Reasoning Toolkit

Movement and navigation are key aspects of spatial reasoning. This poster outlines key developmental steps for children from birth to 7 years. You can encourage children's spatial development by providing ample time for exploration and by using spatial words during play and everyday routines. Spatial reasoning is central to everyday living and research has shown that it is also a strong predictor of future mathematical and scientific attainment

0-6 months	6-12 months	2-year-olds	3-year-olds
Children are learning to: Explore space by moving, rolling, and stretching.	Children are learning to: Engage with spatial relationships, positions and directions, using gestures and concepts like 'in', 'under', 'up', 'down'.	Children are learning to: Find their way around familiar environments, e.g. where they wash their hands.	Children are learning to: Recognise and predict familiar routes e.g. your garage before they use it.
			
Spatial Language: 'to', 'far', 'nearby'	Spatial Language: 'left', 'up', 'right', and 'over there'	Spatial Language: 'next to', 'behind' and 'all the way over there'	Spatial Language: 'next', 'look under', 'after', 'before'
4- and 5-year-olds	4- and 5-year-olds	6- and 7-year-olds	6- and 7-year-olds
Children are learning to: Follow and give directions, including left and right turns when accompanied by gestures.	Children are learning to: Notice landmarks and use these to find their way around familiar places.	Children are learning to: Predict the path of travelling objects, using the language of position, direction, and orientation.	Children are learning to: Place things at approximately correct relative distances when creating maps or 2D models and identify representations of real-world features.
			

# Maths family postcards in 10 languages – so far

**Walking to the shops**

counting  
Let's count the steps!

estimating  
I wonder - how many dogs we will see on the way to the shop today?

direction & routes  
Which way do we go now? Which way do we go now?

what they enjoy doing • Join in and use these ideas when they seem ready




**Getting dressed**

counting  
1 sock, 2 socks!

counting  
1, 2, 3, 4, 4 poppers fastened up.

which way round?  
Oh no! It is upside down / inside out! Let's turn it around.

size & pattern  
Are these your gloves or are they too small / big for your hands? Do they match?

position  
Your shoes need their buckles on the outside of each foot.

what they enjoy doing • See what they enjoy doing • Join in and use these ideas when they seem ready




**In the bath**  
(or water play with a boy pool or sink)

comparing capacities  
Would you like this big jug or this small jug?

comparing capacities  
Let's pour all of the water from the yellow pot into this blue pot, what do you think might happen?

Let's will fill cups

Let's half-fill these ones we can both have the same amount of 'drink'.

what they enjoy doing • See what they enjoy doing • Join in and use these ideas when they seem ready




**Making a snack**

comparing & how many  
How many would you like? 1 or 2?

shape  
What shape is your toast or...

size  
Would you like the big spoon or the small spoon to eat that?

what they enjoy doing • Join in and use these ideas when they seem ready




**Playing with dough**

how many  
Candles! Whose birthday is it? How old are they? Have we the right number of candles so we can sing?

estimation & size  
How many biscuits do you think you can make with that cutter?

counting / how many?  
How many pieces have you cut it into?

volume  
Let's share the dough so we all have the same amount. How shall we do that?

length  
Who can make the longest worm with their dough?


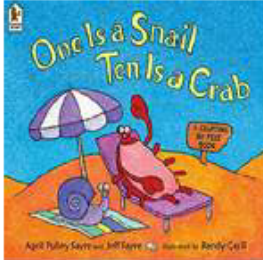
what they enjoy doing • See what they enjoy doing • Join in and use these ideas when they seem ready




The collection of all the postcards or print.

# Picture book lists

CHILDHOOD  
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	<p><b>Mouse count</b> Ellen Stoll Walsh</p> <p>3 to 5</p> <p><a href="https://www.youtube.com/watch?v=oA5QeZhDJEs">https://www.youtube.com/watch?v=oA5QeZhDJEs</a></p> <p>Also available in Spanish</p>	<p>A hungry snake collects sleepy mice into a jar, adding on each time, but the mice trick him and escape, 'uncounting' themselves.</p>	<p><b>Counting and cardinal number values to 10</b> <b>Ordinality - number order: counting back</b> <b>Adding by counting on</b></p> <p>The snake demonstrates adding by counting on. Children can use this strategy by adding their own numbers of toy mice or pebbles into a jar and count back as they remove numbers of 'mice'. This video from the Erikson website shows two ways of developing the story, large scale and small scale: <a href="https://earlymath.erikson.edu/mouse-collections-preschool-storytime-game/">https://earlymath.erikson.edu/mouse-collections-preschool-storytime-game/</a></p>
	<p><b>One is a snail, ten is a crab</b> April &amp; Jeff Sayre</p> <p>3 to 7</p> <p><a href="https://www.youtube.com/watch?v=zDjp7rTXtsk">https://www.youtube.com/watch?v=zDjp7rTXtsk</a></p>	<p>A counting by feet book: a snail has one foot, a person has 2, a dog has 4, crabs have 10... So 40 can be made with 4 crabs or 10 dogs.</p>	<p><b>Counting and cardinal number values to 100</b> <b>Adding combinations of 2s, 4s, 10s etc</b> <b>Counting in 10s</b> <b>Composition</b> <b>Problem solving</b></p> <p>Children can make numbers to 20 with say, snails people and dogs - or make other numbers with other creatures. You could provide animal pictures or toys and invite children to make numbers in different ways using the animals e.g. <i>How many ways can you show eight feet?</i> Children could record their combinations in their own ways. Very young children also enjoy the book: see <a href="#">Mathematical Moment One is a snail</a></p>



# Positive relationships and maths

“Most of us probably have a good idea what it takes to get our young children to love reading. Snuggling up with a favourite book at bedtime, for example, sends a clear message about the value of reading.

**But what about a love of math?”**

Brownell (2021)

<https://earlymath.erikson.edu>



Image: Crown Copyright (2009)