

Mathematical thinking

Early childhood learning trajectories

What is mathematical thinking?

Mathematical thinking is embedded in children's everyday lives. Research shows mathematical thinking and learning starts in infancy and develops into adulthood. It includes learning about mathematical concepts and applying them in everyday situations. Mathematical thinking involves 4 subdomains, including these skills and ways of thinking:

- <u>Patterns and predictions</u>: noticing patterns (repetition of 2 or more items) and predicting what comes next, which is the foundation of mathematical and logical thinking.
- <u>Shapes and spatial thinking</u>: describing physical objects, including what type of object they are (and why), their position relative to each other and their direction of movement.
- <u>Measurement and data</u>: understanding units of measurement (for example, length, weight and area) and using broader mathematical knowledge to answer simple questions through a process of collecting, interpreting, representing and communicating information.
- <u>Quantity and counting</u>: naming numbers in sequence and connecting them to quantities, and using actions, objects or numbers to represent quantities symbolically.



Early Years Learning Framework

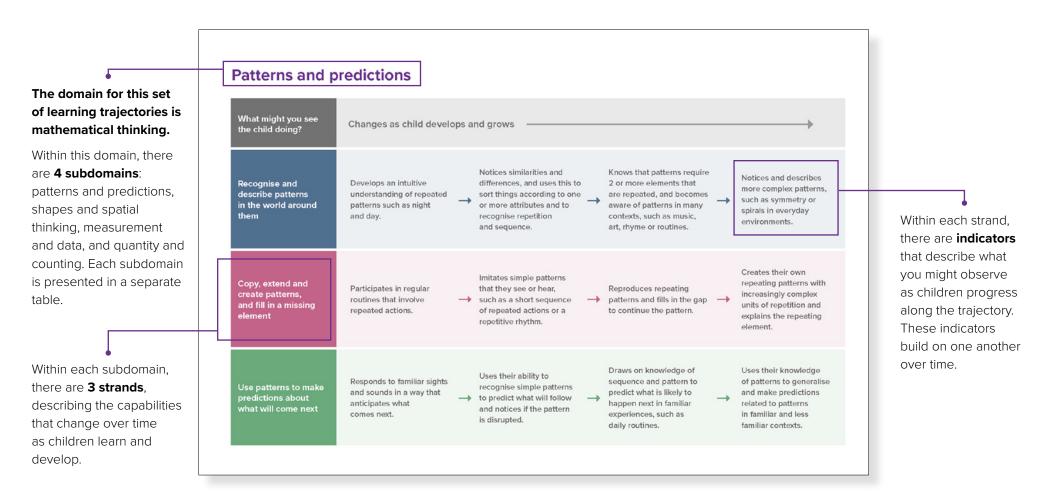
AERO's Early Childhood Learning Trajectories align with the principles, practices and outcomes of the Early Years Learning Framework V2.0. The Early Childhood Learning Trajectories: User Guide provides further information and demonstrates how the Learning Outcomes can be mapped to domains.

National Quality Standard

Quality Area 1 – Educational program and practice

How to use the Early Childhood Learning Trajectories

These learning trajectories will help you observe children's progress in mathematical thinking. They will give you language and ideas for documenting children's learning and development, and for your conversations with families and colleagues about children's progress. The trajectory is not a checklist. You are encouraged to use your professional knowledge and judgement in determining how each child may demonstrate progress along each trajectory, and how best to support their learning.



Patterns and predictions

What might you see the child doing?	Changes as child develops	and grows				
Recognise and describe patterns in the world around them	Develops an intuitive understanding of repeated patterns such as night and day.	Notices similarities and differences, and uses this to sort things according to one or more attributes and to recognise repetition and sequence.	→	Knows that patterns require 2 or more elements that are repeated, and becomes aware of patterns in many contexts, such as music, art, rhyme or routines.	→	Notices and describes more complex patterns, such as symmetry or spirals in everyday environments.
Copy, extend and create patterns, and fill in a missing element	Participates in regular routines that involve repeated actions.	Imitates simple patterns that they see or hear, such as a short sequence of repeated actions or a repetitive rhythm.	→	Reproduces repeating patterns and fills in the gap to continue the pattern.	→	Creates their own repeating patterns with increasingly complex units of repetition and explains the repeating element.
Use patterns to make predictions about what will come next	Responds to familiar sights and sounds in a way that anticipates what comes next.	Uses their ability to recognise simple patterns to predict what will follow and notices if the pattern is disrupted.		Draws on knowledge of sequence and pattern to predict what is likely to happen next in familiar experiences, such as daily routines.	→	Uses their knowledge of patterns to generalise and make predictions related to patterns in familiar and less familiar contexts.

Shapes and spatial thinking

What might you see the child doing?	Changes as child develops and grows					
Recognise and describe shapes and spaces in the world around them	Uses their body to explore the shapes and spaces.	Begins to match shapes (for example, same), and uses simple words and gestures to describe location and direction (for example, 'there', 'up').	→	Uses more precise language to describe shapes (for example, 'pointy', 'round'), location (for example, 'near') or direction (for example, 'forwards').	→	Describes more complex attributes of shapes (for example, 'sides', 'corners') and explains relative positions (for example, 'on top', 'in front').
Manipulate shapes and objects to create new forms or positions	Changes the position of their body or an object, or looks at objects from different perspectives.	Manipulates shapes and objects experimentally to change their form or position.	→	Manipulates shapes and objects purposefully and accurately.	→	Flips, slides and rotates shapes and objects in accordance with a mental image.
Describe and represent the relations between shapes or positions	Moves their eyes or body in the direction of a desired object and recognises items are still there even if not visible.	Sorts or stacks objects by shape, and organises groups of objects into desired positions.	→	Uses words to describe the location of things in relation to each other (for example, 'beside', 'next to', 'between') and classifies shapes according to their similarities and differences.	→	Connects representations of places and shapes with physical realities (for example, uses a simple map or identifies a three- dimensional object using a two-dimensional image).

Measurement and data

What might you see the child doing?	Changes as child develops and grows				
Understand that measurement involves units	Becomes aware of size and distance as they explore the environment.	Becomes aware that things have attributes that can be measured, and explores these attributes.	 Develops knowledge about how measurement works, including the use of consistent units that have no spaces between them, and the tools that can be used. 	→	Estimates measurements such as length and height, and discusses their reasoning using informal and formal tools to test their estimates.
Explore and compare length, height, weight, area or volume	Explores length, height, volume and area instinctively in play and routine experiences.	Uses and understands words that describe measurement concepts (such as 'big' or 'small', 'full', 'empty' or 'heavy').	Begins to use measurement concepts in their play and interactions, such as discussing length of time or volume of materials.	→	Compares objects, describes their attributes using measurement concepts (for example, 'area' and 'volume'), and order them by size.
Collect, interpret, represent and communicate information	Instinctively gathers information about their world through observation and experience.	Investigates the world more purposefully, collecting information about topics or problems of interest.	 Frames and investigates questions and wonderings using mathematical ideas (for example, 'How many?', 'How often?'). 	\rightarrow	Interprets and represents data in a way that answers a question using physical objects or simple visual representations.

Quantity and counting

What might you see the child doing?	Changes as child develops and grows				
Represent quantity symbolically	Uses body movement to indicate simple concepts of quantity, such as showing when they have had enough or want more.	Understands the relationship between words for quantity and physical objects (e.g., 'some', 'more or less').	Uses drawings to represent quantity or small objects to show what a specific quantity looks like.	→	Represents increasingly large quantities, beginning to use numerals, as well as objects or drawings.
Count objects	Tells the difference between quantities in what they see and notice when quantities change.	Uses body parts or objects to simulate or imitate counting, such as in counting songs or rhymes.	Begins to count small sets using one-to-one correspondence, naming numbers while pointing to or touching the relevant object.	→	Shows an understanding of order, such as first, second and third, and recognises that the last number of a set represents the total amount.
Say or sign number words in the correct sequence	Says or signs number words, sometimes running into one another in a sing-song way.	Says or signs some number words clearly, although not necessarily in the correct order.	Says or signs number words in the correct sequence up to 5 and then to 10.	→	Counts verbally or recites number words back from 10.

Creating opportunities to support children's mathematical thinking

Patterns and predictions

- Help children to notice patterns in their everyday experiences, including following predictable routines for pre-verbal children.
- Talk about the unit of the pattern that repeats, such as designs on fabric, table settings (such as spoon, fork, cup) or events in the day.
- Help children to become pattern finders by encouraging them to learn about and find 'units of repeat' such as 'ABCABC' or 'blue-red-blue-red'.
- Encourage children to create patterns and play with variations, including drawing, painting, play dough actions and songs.

Shapes and spatial thinking

- Provide a range of shapes and objects in the physical environment, including large obstacles to navigate and smaller objects to move around.
- Find opportunities to support spatial thinking in interactions with children, describing the position of an object and using shape language.
- Notice and discuss children's purposeful manipulation of shapes and spaces, including in block play, jigsaws, dancing or tidying up.

Measurement and data

- Encourage children to investigate measurement concepts through play such as exploring size, length, height and weight.
- Demonstrate effective measurement strategies – for example, lining blocks up to measure the length of the table and showing consistency with start and end points, consistency with units of measure (the blocks), and knowing there are no spaces in between each unit.
- Encourage children to estimate the length and height of an object or area and then use informal and formal tools to check and reflect on their initial ideas.

Quantity and counting

- Show children that counting tells us how many. Draw attention to numerals in the environment (for example, in books, on the clock or on posters).
- Use every opportunity to count verbally (such as in songs and rhymes or in routines) and support children in learning the number words.
- While you count, point to the objects you are counting and move them to one side to show which ones still need to be counted.
- When children tell you 'how many' without counting, ask how they know, count together to check and emphasise the total number.

About this resource

Our Early Childhood Learning Trajectories are designed for teachers and educators working in early childhood education and care (ECEC) services with children in the years before school. They can support ongoing professional learning, for individuals, and entire ECEC services and teams.

The Early Childhood Learning Trajectories describe how children learn and develop in these key domains:

- Executive functions
- Social and emotional learning
- Mathematical thinking
- Language and communication
- Physical development.

While each learning trajectory describes children's progress in a single domain, they are designed to be used in interconnected ways. A single experience may support progress in multiple domains at the same time. Progress in one domain may depend on progress in another.

Further reading

For more information on our learning trajectories research

- Early Childhood Learning Trajectories: User Guide
- Early Childhood Learning Trajectories: The Evidence Base

More information

The AERO website features <u>further guidance</u>, including practice guides and case studies for early childhood practice. Visit <u>edresearch.edu.au</u> for more information.

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