



A Curriculum  
Framework for  
Preschool Education  
in Singapore



**EDUCATORS'  
GUIDE FOR  
NUMERACY**

Copyright © 2023, Ministry of Education  
Republic of Singapore  
Earlier editions published by Ministry of Education,  
Singapore in 2003 and 2013.

All rights reserved. This publication shall not  
be reproduced, stored in a retrieval system,  
or transmitted in any form or by any means,  
electronic, mechanical, photocopying, recording, or  
otherwise, without the prior written permission of  
the copyright owner.

All information contained herein is correct at the  
time of printing.

ISBN: 978-981-18-7429-1

# CONTENTS

---

<b>ACKNOWLEDGEMENTS</b>	4
<b>OVERVIEW OF EDUCATORS' GUIDES</b>	5
<b>CHAPTER 1:</b>	7
<b>Numeracy in the Early Years</b>	
• Understanding Relationships and Patterns	12
• Developing Counting Skills and Number Sense	20
• Understanding Basic Shapes and Spatial Concepts	26
<b>CHAPTER 2:</b>	30
<b>Learning Goals for Numeracy</b>	
• Learning Goal 1: Enjoy Learning and Using Numeracy Concepts and Skills in Daily Experiences	31
• Learning Goal 2: Understand Relationships and Patterns	35
• Learning Goal 3: Develop Counting Skills and Number Sense	42
• Learning Goal 4: Understand Basic Shapes and Spatial Concepts	55
<b>CHAPTER 3:</b>	59
<b>Strategies for Numeracy</b>	
• Using Concrete-pictorial-abstract Approach	61
• Using Manipulatives and Games	63
• Using Stories, Songs and Rhymes	65
• Asking Prompting Questions	67
• Providing Opportunities for Problem Solving	70
• Using Daily Routines and Transitions	72
<b>CHAPTER 4:</b>	73
<b>Organising the Learning Environment</b>	
• Organising the Physical Environment	74
• Creating a Positive Interactional Environment	89
• Tapping the Temporal Environment	90
<b>CHAPTER 5:</b>	91
<b>Monitoring and Assessing Learning and Development</b>	
• Observing, Documenting and Assessing Children's Learning and Development	93
• Examples of Observation, Documentation and Assessment of Children's Learning and Development	99
<b>BIBLIOGRAPHY</b>	107

# ACKNOWLEDGEMENTS

---

The Ministry of Education wishes to thank Professor Nirmala Rao, Serena H. C. Yang Professor in Early Childhood Development and Education and Chair Professor of Child Development and Education, Faculty of Education, The University of Hong Kong who had provided valuable advice in the development of the document.

We would like to acknowledge the members of the Nurturing Early Learners Framework Review Committee for their advice, feedback and recommendations for the document.

We would also like to express our appreciation to the following preschool centres for sharing their photographs:

- E-Bridge Pre-School @ 178A Rivervale Crescent
- Hebron Christian Preschool
- MOE Kindergartens
- My First Skool at 50 Sengkang West Way
- PCF SparkleTots @ Pasir Ris Blk 517
- Presbyterian Preschool Services
- The Schoolhouse by Busy Bees, Sembawang Country Club

# OVERVIEW OF EDUCATORS' GUIDES

*Nurturing Early Learners – A Curriculum Framework for Preschool Education in Singapore* or NEL Framework was updated by the Ministry of Education (MOE) in 2022. It provides broad principles to guide preschool centres in planning and implementing a quality curriculum for children aged four to six (i.e., Nursery 2, Kindergarten 1 and Kindergarten 2).

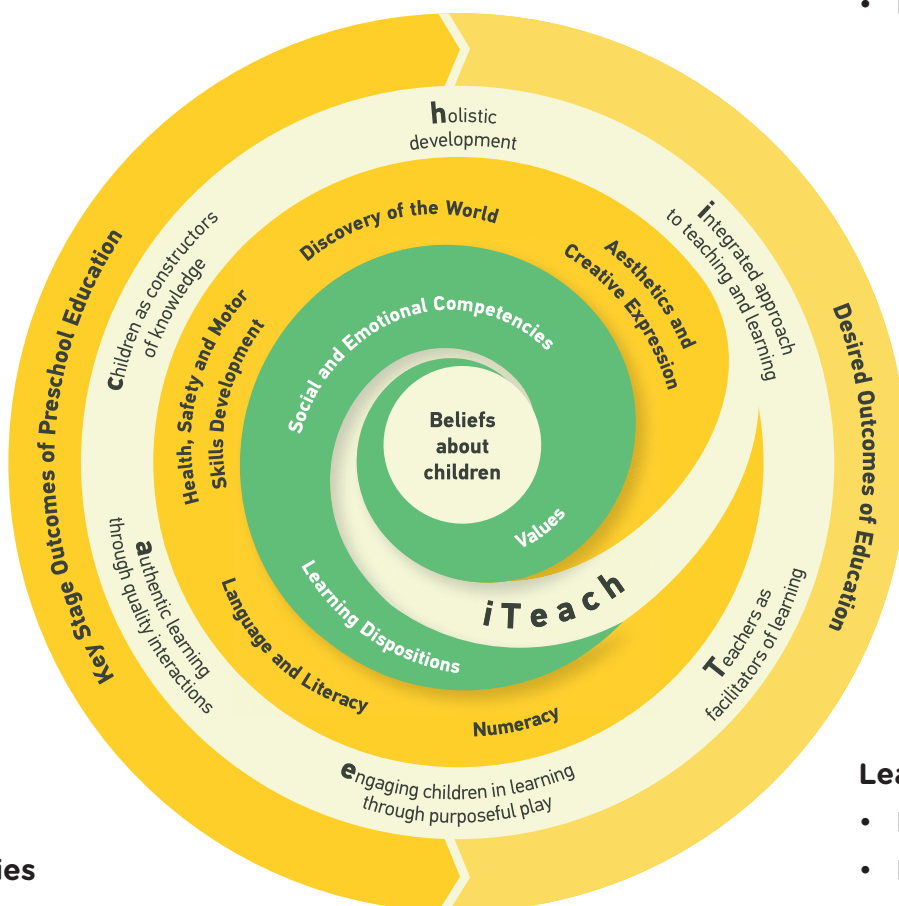
**Figure 1: Key Concepts of NEL Framework**

## Beliefs about Children

- Children are joyful, curious, active and competent learners.
- Children play, learn and grow with others in a diverse and multi-cultural community.

## Values

- Respect
- Responsibility
- Care
- Honesty



## Social and Emotional Competencies

- Self-awareness
- Self-management
- Social awareness
- Relationship management
- Responsible decision-making

## Learning Dispositions

- Perseverance
- Reflectiveness
- Appreciation
- Inventiveness
- Sense of wonder and curiosity
- Engagement

At the centre of the NEL Framework is our beliefs about children. It emphasises the importance of holistic development and nurturing the joy of learning in our children. The NEL Framework places an increased importance on the key aspects of children's learning and development, which include inculcating values, developing social and emotional competencies and fostering learning dispositions. These cut across all learning areas and should be intentionally and consistently incorporated across children's learning experiences as they serve as the foundation for character building, lifelong learning and learning to live harmoniously with others. The NEL Framework also states the key knowledge, skills and dispositions of five learning areas to support children's holistic development.

Teachers play a critical role in stimulating and deepening children's learning based on their understanding of how children develop and learn. The six *iTeach* principles serve to guide preschool teachers in planning, designing and facilitating joyful and meaningful learning experiences which will lay a strong foundation to help children achieve the Key Stage Outcomes of Preschool Education and the Desired Outcomes of Education in Singapore.

## PURPOSE OF THE EDUCATORS' GUIDES

The NEL Educators' Guides seek to help teachers translate the NEL Framework into quality teaching and learning experiences for children. The nine volumes of Educators' Guides provide teaching and learning strategies; examples of learning activities; ways of organising the learning environment; and considerations for observation and assessment of children's learning and development. Each Educators' Guide takes close reference to the principles and learning goals of the NEL Framework. The examples in each Educators' Guide illustrate one or several of the following:



Values



Social and Emotional Competencies



Learning Dispositions



Executive Functioning Skills

1. Nurturing values, social and emotional competencies, learning dispositions and executive functioning skills across learning experiences
2. Promoting learning in, about and through the outdoors
3. Using technology meaningfully and appropriately

The Educators' Guide for *Numeracy* provides ideas for teachers to create and facilitate appropriate and meaningful learning experiences for children through examples and suggestions. Teachers may adapt and modify these examples and suggestions to cater to the interests, needs and abilities of their children.

# Chapter 1

## NUMERACY IN THE EARLY YEARS





**1, 2, 3, 4, 5.**

***I have 5 sticks  
of otah, fresh  
from the grill.  
Would you like  
to buy some?***

The learning and understanding of numeracy concepts and skills enable children to use them confidently in their daily experiences.

Numeracy development in the preschool years involves helping children to identify and use numbers, understand the relationships between numbers, count accurately and recognise patterns, shapes, positions and directions. It also helps children develop positive learning dispositions, such as a sense of wonder and curiosity, inventiveness, perseverance and engagement, improve executive functioning skills and build up skills for life (e.g., logical thinking and reasoning, problem solving skills). The learning and understanding of numeracy concepts and skills enable children to use them confidently in their daily life and lay the foundation for future learning of mathematics in the primary schools.



**Numeracy is seeing math in daily life and using mathematical language and concepts to frame, analyse and explore situations. This is a critical starting point to help children understand and be interested in math.**

Hynes-Berry & Grandau, 2019



When children attend a preschool centre, they bring with them prior knowledge and experiences about numbers, shapes and spatial relationships in the environment based on how these numeracy concepts and skills are being used at home and in the community.



Teachers should build on this prior knowledge by designing learning activities set in relevant and realistic contexts to enable children to make connections between what they already know and can do and what teachers plan for them to learn. These experiences can range from individual to small and large group activities with hands-on learning experiences for children to explore and construct their own understanding. When children have opportunities to explore patterns, shapes, spatial relationships, counting and comparing through manipulating concrete materials, they will observe and notice the relationship between numbers, how numeracy concepts and skills connect to one another and with other learning areas.



**Regular exposure to numeracy learning activities that are intentionally planned and facilitated is critical if children are to acquire important attitudes, skills and knowledge about numeracy.**

Clements & Sarama, 2009



Children's motivation and interest in numeracy can be sustained when they learn through play and recognise how the numeracy concepts and skills are a meaningful part of their everyday activities. **Teachers should provide opportunities for children to learn, use and apply numeracy concepts and skills meaningfully in their daily experiences.** These learning opportunities can also be embedded in their daily preschool routines and interactions, such as arrival and dismissal, transitions, snack, and indoor and outdoor play time.

**Take 3 jumps to complete the race.**  
**Ready? 1,2,3!**



Outdoor play time provides an authentic context for children to learn, use and apply numeracy concepts and skills.

Teachers should take time to observe what children do during these learning experiences, listen to what they say, model the use of mathematical language consistently and facilitate their numeracy development through revisiting, reinforcing and extending the teaching and learning of the numeracy concepts and skills. Teachers should also provide children with opportunities to communicate their ideas, clarify their thoughts and share their thinking about how they solve a problem or come up with a solution.



Teacher observes and listens to children's conversation during a numeracy game to monitor their progress in counting reliably up to 10 things.

**Children take time to develop numeracy concepts and skills.** A child who appears to be engaging successfully in numeracy activities may not necessarily understand the underlying concepts. Children may also appear to have developed an understanding of the numeracy concept/skill in one context but then fail to show that knowledge in a different context.

To facilitate and scaffold children's numeracy learning and development, teachers should consider:

### **Making learning fun and meaningful**

- Start with children's interests to motivate them to learn numeracy concepts and skills.
- Use examples from children's daily experiences and immediate environment to help them see the relevance of numeracy in their daily life.

### **Providing concrete and authentic experiences**

- Allow children to manipulate concrete objects to explore new concepts, revisit learned concepts and practise skills through first-hand experiences.
- Encourage children to use and apply numeracy concepts and skills to solve real life problems to help them make sense of the world around them.

### **Making connections across learning experiences**

- Build on children's prior knowledge and design learning activities to enable them to make connections between what they already know and can do and what they are to learn to promote conceptual understanding.
- Make links between numeracy learning and development and other learning areas in the preschool setting to foster the holistic development of children.

### **Using mathematical language**

- Model the use of mathematical language frequently and consistently in the context of children's everyday experiences to build their understanding and confidence in using numeracy concepts and skills.
- Encourage children to share ideas, solutions and reasons using mathematical language when problem solving to make their learning and thinking visible.

Research shows that children who have a good foundation in numeracy during their preschool years make better progress in mathematics learning at primary school. **In the preschool years, the focus should be on the learning and development of the following foundational numeracy concepts and skills:**

Relationships and  
Patterns

Counting  
and Number Sense

Shapes and  
Spatial Concepts

## UNDERSTANDING RELATIONSHIPS AND PATTERNS

Knowing relationships through matching, sorting, comparing, ordering and patterning helps children to exercise and build on their logical thinking capabilities. These thinking skills are foundational to understanding numbers and the number system.

### Matching

**Matching involves seeing a relationship or noticing that things are the same or have something in common.** For example, a child puts two toy cars together as they are of the same model and puts two red flowers together as they have the same colour. To help children understand the concept of sameness, they should be provided with opportunities to match objects using other attributes, such as shape, size, length, texture, function (e.g., kitchen utensils like fork and spoon) and other attributes determined by the children. Understanding the concept of sameness will also enable children to match a picture card of five cars to a picture card of five chairs as both have the same quantity. In addition, when children are provided with ample opportunities to match one object with another, they progress through their learning and develop the ability to match each object counted with a number name when they are learning to count reliably.

*Our bears are the same. They are yellow. They have the same colour.*



Provide ample opportunities for children to match objects to develop their conceptual understanding of sameness.



## Sorting

While matching involves looking for things that are the same, **sorting involves looking for things that are different from the rest**. Sorting follows from matching and is more difficult than matching because children need to know which objects are the same and which are different, and then put them in the respective groups.

*These are my bears. I put the yellow bears in my box. Your bears are purple and red. They have a different colour.*



Children develop logical thinking and reasoning when they put objects into groups according to attributes.

Similarly, as in matching, children need to have a concept of the attribute they are using to sort the objects. A child can use attributes, such as colour, shape, size and child-determined attributes in sorting. Once the child is familiar using a single attribute to sort things, his/her thinking can be further challenged by providing opportunities to sort things using two attributes, such as colour and shape and shape and size. Putting objects in groups and dealing with the relationships within a group and among different groups help children develop logical thinking and reasoning.

### DID YOU KNOW?



Asking children to think of different attributes to match or sort objects helps to promote the development of cognitive flexibility as they learn to be flexible in their thinking and approach a situation/problem in more than one way.

## Comparing

**Comparing involves looking at two objects or two sets of objects and finding how they are similar and different.** When children make comparisons, they notice a relationship between two objects in terms of attributes, such as size (e.g., one car is bigger than the other car) and length (e.g., the rope is longer than the string).

**Teacher:** *Which ribbon should we use to wrap this present?*

**Child:** *Red ribbon!*

**Teacher:** *Why should we use the red ribbon?*

**Child:** *It is longer. The blue ribbon is too short to wrap the present.*



Children develop a sense of measurement when they compare and recognise the relationship between two objects in terms of their attributes, such as size or length.

The comparison words adults use, such as bigger, smaller, longer and shorter to describe objects will raise children's awareness of making and describing comparisons. As children progress in their learning and development, they build on their abilities to compare and put things in order which will help them to develop a sense of measurement.

### DID YOU KNOW?



Providing children with the opportunity to understand that the same object can be described differently (i.e., shorter or longer), depending on the focus of comparison, will also promote the development of their cognitive flexibility.

## Ordering

**Ordering involves comparing more than two objects or two sets of objects and putting them in a certain order**, such as by size (i.e., from smallest to biggest or biggest to smallest) or length (i.e., from shortest to longest or longest to shortest). It is more difficult than comparing because now children must make several decisions. For example, with three straws of different lengths, the middle straw must be longer than the preceding one but shorter than the following one when one orders them from shortest to longest. When children have acquired the understanding of how they can compare and order objects by attributes, such as size or length, they can then progress to learning how they can measure and compare the size or length of objects using non-standard units (e.g., craft sticks, paper clips) in primary school.

The skill of ordering is foundational to learning to recite numbers in sequence (i.e., in ascending and descending order) and understanding the number system (i.e., to know that numbers have a sequential relationship, e.g., '4' is one more than '3' and one less than '5'). This conceptual understanding is essential for children to know how to order sets of objects based on quantity and later, the learning of number operations, such as addition and subtraction.



Ordering is a foundational skill for learning number sequence and understanding the number system.



**Ordering includes the sequencing of events.** As the concept of time is abstract to children, providing them with opportunities to order events that are familiar and relevant to them helps them learn to relate time to their personal experiences. This includes the ordering of events and activities in chronological order (e.g., breakfast, lunch and dinner, life cycle of plants and animals, story sequence) and knowing the order for days of a week and months in a year.

Opportunities where children may order events in their own lives are meaningful and authentic learning experiences for them to learn and understand the skill of ordering. They can make sense of their personal life as they consider the sequence of events that make up their daily experiences (e.g., get up in the morning, have breakfast, go to school), passing of time (e.g., celebrating festivals or events, such as New Year's Day, Lunar New Year, Hari Raya Puasa, Dragon Boat Festival, National Day, Mid-Autumn Festival and Deepavali). These would support children's later learning and understanding of the notion of time measured by clocks.

## Patterning

**Patterning is a form of ordering.** Children need to identify the similarities and differences between objects based on the attributes (e.g., colour, shape, size, texture, type), as well as their order (i.e., what comes before and what comes after) to do patterning. They usually begin to do patterning that contains an element of repetition, and they can use attributes, such as colour, shape and size as the core of a pattern. For example, the arrangement of yellow car (A), red car (B), yellow car (A), red car (B), yellow car (A), red car (B) is an example of a repeating AB pattern using colour (i.e., yellow and red) as the core unit of the repeating pattern.

*Look! I am going to use the flower cut-outs to decorate the paper.  
Red, pink, red, pink, red, pink ...*



Children begin to do patterning by using attributes, such as colour, shape and size as the core of a pattern.



Children identify patterns when they notice regularities in the environment around them, such as patterns on clothing, brick patterns on buildings, patterns on a sidewalk or zebra crossing, patterns on a leaf, and the cycle of day and night.

Children should be provided with ample opportunities to identify patterns in their environment before getting them to extend and create patterns. They can identify, extend or create patterns using various manipulatives, such as stringing beads or arranging pattern blocks in a specific AB pattern (e.g., square, circle, square, circle, square, circle). When using manipulatives to get children to extend the pattern, ensure that the core unit of the pattern is shown by repeating it about three times to allow them to identify the core unit in order to extend the pattern. Teachers can also use actions and auditory patterns (e.g., clap, snap, clap, snap, clap, snap) for children to identify or replicate the pattern.



## DID YOU KNOW?



Getting children to recognise auditory patterns helps them develop and improve their working memory as they would need to listen attentively and remember the pattern in order to replicate it.

Once children are able to recognise and explain the underlying order and predictability in the patterns they observe, they will extend and begin to create their own patterns. More complex repeating patterns (e.g., ABCABCABC, AABBAABBAABB) and growing patterns (e.g., AB, ABB, AB BB) can be introduced to raise children's awareness of the possible variety of patterns. Building children's ability to recognise and describe that a repeating sequence of objects makes a pattern, and being able to copy, extend and create a new pattern are the early steps towards supporting children's understanding of more abstract concepts of number patterns and spatial patterns, and subsequently, algebra learning in primary school.

**Matching, sorting, comparing, ordering and patterning are essential pre-number concepts/skills that children should develop before learning about numbers.** While there is some sequence in which these concepts and skills may be developed, the development does not take place in a clear or linear manner. Children may develop several of these concepts and skills at the same time and individual children may move through the concepts and skills in different sequences. The suggested learning and developmental progression of the pre-number concepts and skills is shown in the table on the next page. It highlights that the concept and skill development progresses over time and is from simple to complex across and within the individual concepts and skills.

Simple

Complex

Simple

Matching	Sorting	Comparing	Ordering	Patterning
<ul style="list-style-type: none"> <li>• Put the same type of objects together</li> <li>• Put objects of the same colour, shape or size together</li> <li>• Put objects of the same length or height together</li> <li>• Put objects together based on child-determined attributes</li> <li>• Put objects together based on two or more attributes</li> </ul>	<ul style="list-style-type: none"> <li>• Pick out one category of objects from an assortment of objects</li> <li>• Group two categories of objects (e.g., balls and books) from an assortment of objects</li> <li>• Group objects by colour, shape or size</li> <li>• Group objects by length or height</li> <li>• Group objects by simple features (e.g., texture or type of material)</li> <li>• Group objects by child-determined attributes</li> <li>• Group objects by two or more attributes</li> </ul>	<ul style="list-style-type: none"> <li>• Compare objects by size</li> <li>• Compare objects by length</li> <li>• Compare objects by height</li> </ul>	<ul style="list-style-type: none"> <li>• Put three or more objects in an order according to size</li> <li>• Put three or more objects in an order according to length or height</li> <li>• Put three or more objects in an order according to child-determined attributes</li> </ul>	<ul style="list-style-type: none"> <li>• Recognise and copy simple patterns (e.g., ABABAB, ABBABBABB, AABAABAAB)</li> <li>• Recognise and extend simple patterns</li> <li>• Create simple patterns</li> <li>• Recognise and extend complex patterns (e.g., AABBAABBAABB, ABBAABBAABBA, ABCABCABC)</li> <li>• Create complex patterns</li> </ul>

Complex

## DEVELOPING COUNTING SKILLS AND NUMBER SENSE



Counting skills and number sense help children understand the concept of numbers and their relationships.

Counting and number sense is a core content area in any early childhood numeracy curriculum. Acquiring counting skills and developing number sense help children understand the concept of numbers and their relationships. Children should be provided with ample authentic and meaningful learning experiences where they need to count, compare, combine and take apart numbers.

**Numbers can be used or encountered in three ways, i.e., cardinal, ordinal and nominal.**

Children should be provided with opportunities to experience and understand the different aspects of a number.

- **Cardinal numbers** tell us the amount of something (i.e., how many) and are used for counting (i.e., one, two, three, four, etc.). For example, when someone says, *"We have two legs"*.

### DID YOU KNOW?

Some studies highlighted that the ability to understand cardinal concept of numbers and skills of determining the quantity in a set of things are often lacking among children with mathematical difficulties (Baroody, 2010; Geary et al., 2000). In other studies, the findings suggested that knowing the last number counted represents the quantity of the set, the ability to recognise small quantities immediately (i.e., subitizing) and understanding "more than" and "less than" are some predictors of success in later learning of mathematics (Baroody, 2010; Jordan et al., 2009; Chard et al., 2005).

- **Ordinal numbers** tell us the order or position of things in a set (i.e., first, second third, etc.). For example, when someone says, "*Marcus is the third child in the family*".
- **Nominal numbers** are numbers used as labels for identifying something like telephone number, bus number and postal code. For example, when someone says, "*I take bus number '2' to school*".

Teachers should help children develop their fluency and accuracy in counting accurately and a strong number sense. It is vital to ensure that children have a full understanding of smaller numbers before getting them to learn larger numbers. Teachers should thus **focus on the first few numbers or smaller numbers (i.e., 1 to 10) during the preschool years. This helps children discover patterns and simple rules in the number system which they can use and apply to learning larger numbers in the future.** With a strong number sense, children can understand better the concepts of quantity, comparison of numbers, conservation of number and part-whole relationships.

## Counting

Counting is foundational to later learning of mathematics. In order to develop a strong understanding of quantity, and eventually how to manipulate quantities (i.e., operations like addition and subtraction), children need an abundance of counting experiences. The two major counting skills are **rote counting** and **rational counting**.

### Rote counting

Rote counting is reciting the sequence of number names, i.e., one, two, three, and so on. **Reciting the number names does not mean the children know what these number words mean.** It could be done based on memory, just like reciting the letters of the alphabet which children can learn through number songs and rhymes.

#### DID YOU KNOW?

Learning the sequence of number names does not ensure that children can count with accuracy and understand the number as they are just saying the numbers in the correct sequence. But children who have not learnt to recite the correct sequence of numbers will not be able to count with meaning.

### Rational counting

Beyond knowing the numbers in sequence, counting requires children to link a single number name with one and only one object counted at a time, i.e., **one-to-one correspondence**; this ensures they can count reliably. Children need to coordinate touching the object and counting verbally so that these happen at the same time. Children who have not developed one-to-one correspondence may skip an object, count an object more than once, touch more than one object when they say one number, or conversely, say several numbers and touch only one object.

As children explore and count sets of objects, they begin to understand and connect the number name and numeral to the quantity. They must learn that the final number in counting the objects does not just label the last item counted but also represents the total number of items in the set. They would have to use their working memory skills to hold the last number counted in mind when asked to indicate the quantity of the set of items. The ability to count reliably involves the following four counting principles:

### One-to-One Correspondence

#### What is it about?

Knowing that each object is matched to one and only one number name in the set to be counted

#### How does it look like?

A child is able to recite the number names in order, touching the object and counting aloud at the same time, and keep track of which objects have and have not been counted.

### Stable Order

#### What is it about?

Knowing that number names will always be said in a fixed order and that the order of the numbers will not change

#### How does it look like?

A child is able to reproduce the number order as given in the number line and to count up or down from a given number.

A child who counts “one, two, three” for a collection of three objects and “two, one, three” for another collection of three objects does not have an understanding of the stable order principle, although the child would appear to have an understanding of one-to-one correspondence.



## Cardinality

### What is it about?

Knowing that the final number in the count represents the total number of objects in the set

The understanding of cardinality in counting is dependent upon the understanding of the one-to-one correspondence and stable order principles.

### How does it look like?

A child is able to count the objects one by one and use the last number counted to determine the quantity in a set.

To develop children's cardinality in counting, it would be easier for them to first count with tangible objects before they proceed to non-physical things such as sounds, and even counting letters in a word or words in a sentence.

## Order Irrelevance

### What is it about?

Knowing that objects can be counted in any order or in other words, the total number of objects will remain the same regardless of the order in which the objects are counted or which number name is assigned to each object

### How does it look like?

A child is able to determine the same quantity in a set by counting the objects from left to right, from right to left or from any other point.

Children will learn through their counting experiences in the real world that anything can be counted, whether seen, heard or imagined. They will also learn that the principles of counting can be applied to any number and counting situation. Once children can count reliably, their knowledge of the number sequence can be extended to both counting forward and backward from any given number.

## DID YOU KNOW?



When children learn how to count, not only do they develop their understanding of numeracy concepts and skills but their executive functioning skills, too. As children engage in a counting activity, they need to simultaneously keep track of which number they just said (working memory) and not count the same object more than once (inhibitory control).

As children learn to count, modelling different ways to determine the quantity is important. Providing opportunities for children to make an estimate before they count a set of things helps them gain confidence in learning and using numbers. As children gain confidence in estimating small quantities, they can be provided with larger quantities to estimate and an opportunity to count and check their answer. This will help them understand that **estimation is not a random guess, but an informed guess based on what they know about numbers.**

Children learn through hands-on experiences in which they can explore using their senses. It is thus important to provide children with counting experiences involving concrete manipulatives which they can see and touch.

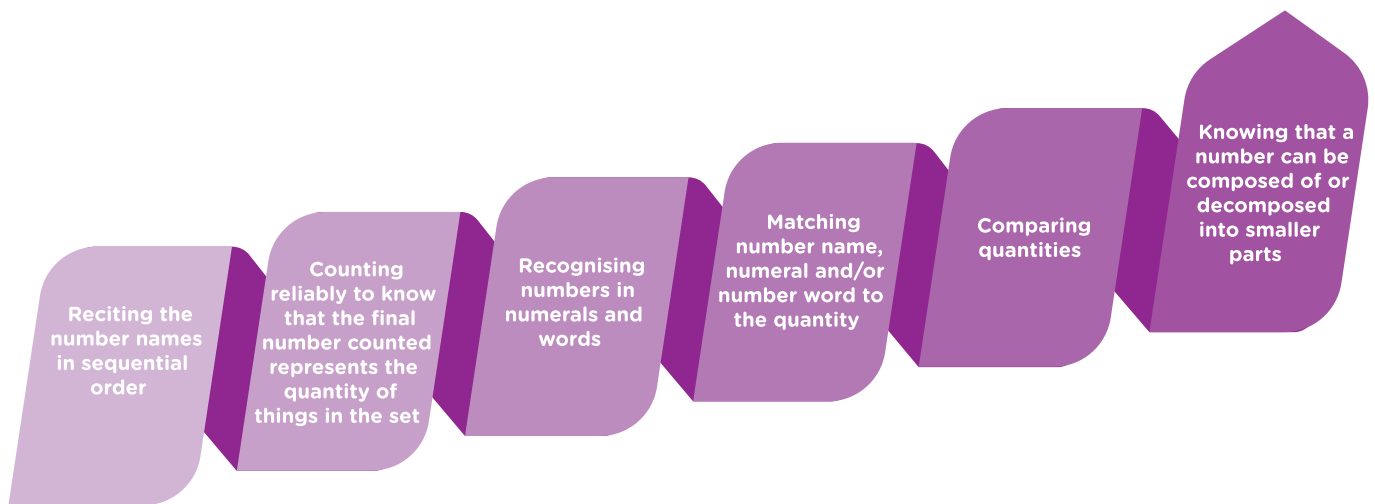
**When teaching a new concept, it is important to start with the concrete and move to the abstract.** For example, money is an abstract concept that is difficult for children to grasp. Children may recognise the numerals on the coins and notes of the different denominations but may not know their value or the difference between the money denominations. They may think that coins have more value than notes and regard a 20-cent coin as being worth more than a two dollar note, or three 20-cent coins as being worth more than a one-dollar coin. Hence, learning experiences to introduce the concept of money in the preschool years normally involve providing children with opportunities to handle money and use it in a meaningful context. These opportunities include creating learning experiences during pretend play for children to role-play selling and buying things (e.g., using props, such as tokens, play money of different denominations, a toy cash register at a pretend supermarket or restaurant). These experiences help children understand that they need to pay for things they buy and begin to recognise and identify different money denominations. It is also useful to start inculcating good saving habits and values in children such as instilling a sense of responsibility towards saving, spending and sharing money.



## Number Sense

Number sense is beyond knowing number names or counting. It is about understanding the relationships between numbers and quantities. It includes basic skills, such as understanding more/or less, longer/shorter, bigger/smaller, the ability to subitise small amounts, understand conservation of number, comparison of numbers and part-whole relationship.

- **Subitising** (i.e., the instant recognition of the quantity of a collection of objects without the need to count them one by one) is an important skill that relates to the development of children's number sense. Children who can identify small quantities in different arrangements, such as those on dominoes or dice, without counting them one by one, are developing their understanding of number conservation.
- **Conservation of quantity** is the understanding that the quantity does not change with the physical rearrangement of objects in a set. For example, spreading out or putting closely a group of objects does not affect its quantity. When children understand conservation of number, they know that two sets of five objects have the same quantity even if the objects of one set are arranged further apart from one another.
- **Comparison of numbers** helps to show how the numbers are related and is the foundation for understanding operations, such as addition and subtraction. Children often have some concept of "more than" and "same as", and this knowledge should be developed before "less/fewer than" which is a more difficult concept. Numbers are arranged and counted in an order where each number represents a quantity that is one more than the previous quantity. Early numeracy experiences for children should focus on determining whether one set of objects is the same as, more than or less than the other set of objects. For example, when children see a plate of five apples and a plate of two apples, they are able to determine that the plate of five apples has more apples than the plate of two apples. Once children are able to determine that one set of objects is more/less than or the same as the other set of objects, it would then be useful to proceed to focus on getting them to determine how many more or how many less/fewer objects there are.
- **Part-whole relationship** is an understanding that a number can be composed of or decomposed of/broken up into smaller parts. Children should understand that any number can be represented in parts. For example, a set of six bangles can be made up of two and four bangles or five and one bangles. When children can interpret a quantity in terms of its parts, it promotes the development of their cognitive flexibility and lays the foundation for understanding operations such as addition where they understand formal operations, e.g.,  $6 = 2 + 4$  or  $6 = 5 + 1$ , which they will encounter in primary school.



The diagram above shows a possible progression of the learning and development of the concept and skill of counting and number sense. The spiral highlights the development that progresses over time and from simple to complex across the concepts and skills. While there is some sequence in which these concepts and skills may be developed, the development does not always take place in a clear or linear manner. Children may develop several concepts and skills at the same time and individual children may move through the concepts and skills in different sequences.

## UNDERSTANDING BASIC SHAPES AND SPATIAL CONCEPTS

**Child:** *Teacher, I made a square!*

**Teacher:** *How did you make the square?*

**Child:** *I made four sides.*

**Teacher:** *A rectangle also has four sides. Did you make a rectangle or a square?*

**Child:** *It is a square. The four sides are the same.*



Exploring and understanding basic shapes and spatial concepts help to lay the foundation for future learning of geometry.

Understanding shape and spatial concepts is essential for children to make sense of the world as all physical objects possess three dimensional shapes and are located in space within our environment. Identifying and naming shapes help children differentiate and describe things in the environment. Understanding simple spatial concepts involves children being aware of the spatial relationship between them and the people or things around them, and using the language of position (e.g., top, bottom, in front of, behind), direction (e.g., up, down, left, right) and distance (e.g., far and near) to describe them.

Exploration of basic shapes and understanding of simple spatial concepts lay the foundation for future learning of geometry. **Research has shown that children who understand shape and spatial concepts are better at arithmetic, as well as geometry in the later years.**

## Basic Shapes

*Look! I found the squares to make the legs for my dinosaur.*



Children begin to learn about the unique properties of shapes as they explore using shape pattern blocks to create figures.

Children are exposed to various objects in the environment, each of which has its own shape. As they look, touch, and hold these objects, they begin to learn that some shapes have specific names, such as circle, triangle, square and rectangle, and each shape has its unique properties. Children generally start to recognise circles and squares first before other shapes because they are the most regular shapes. They should also be encouraged to talk about the properties of the shapes which will help deepen their conceptual understanding of the basic shapes.

Children should be given opportunities to compare and contrast different types of the same shape (e.g., different types of triangles) and the same shape in different sizes and orientations. This will allow them to use their understanding of the properties of the shape and flexible thinking skills to identify and talk about the similarities and the differences (e.g., different lengths of the sides) of these various shapes.

When children have acquired the knowledge of the basic properties of shapes, they can begin to learn to transform the shapes in various ways. For example, they can put two right-angled triangles together to form a rectangle or cut a square into two triangles. When they manipulate shapes, they also begin to explore how they can fit different shapes together to form new figures.

### DID YOU KNOW?



The ability to see the shape as a whole and its constituent parts helps children to develop cognitive flexibility.

## Spatial Concepts

*Let's put the small blocks on top of the big block to make a roof for the building.*



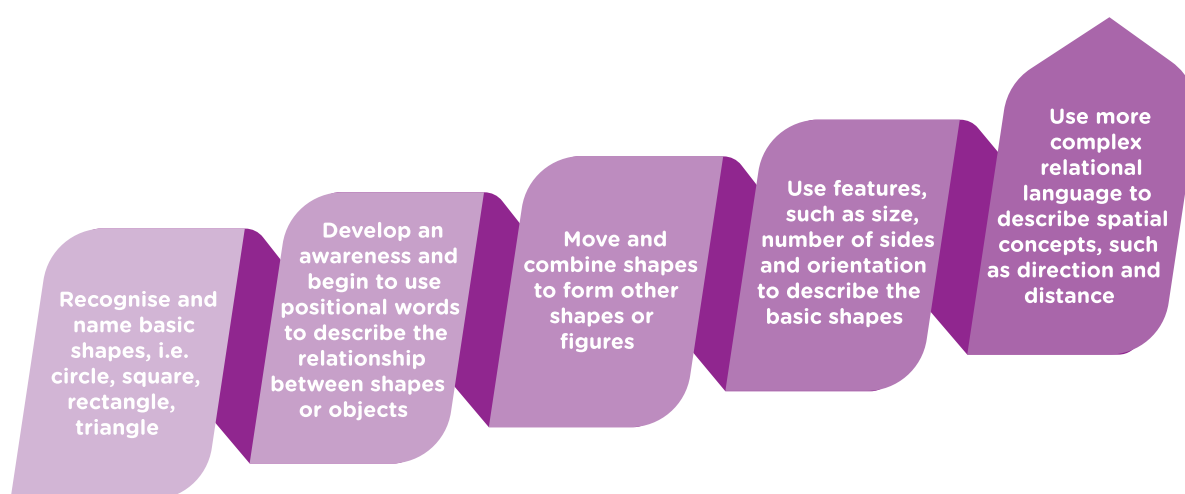
Playing at the Block/Construction Centre helps to promote children's spatial awareness and understanding.

For children, developing spatial or orientation awareness starts with knowing where they are in relation to the things around them and the language of position, direction and distance.



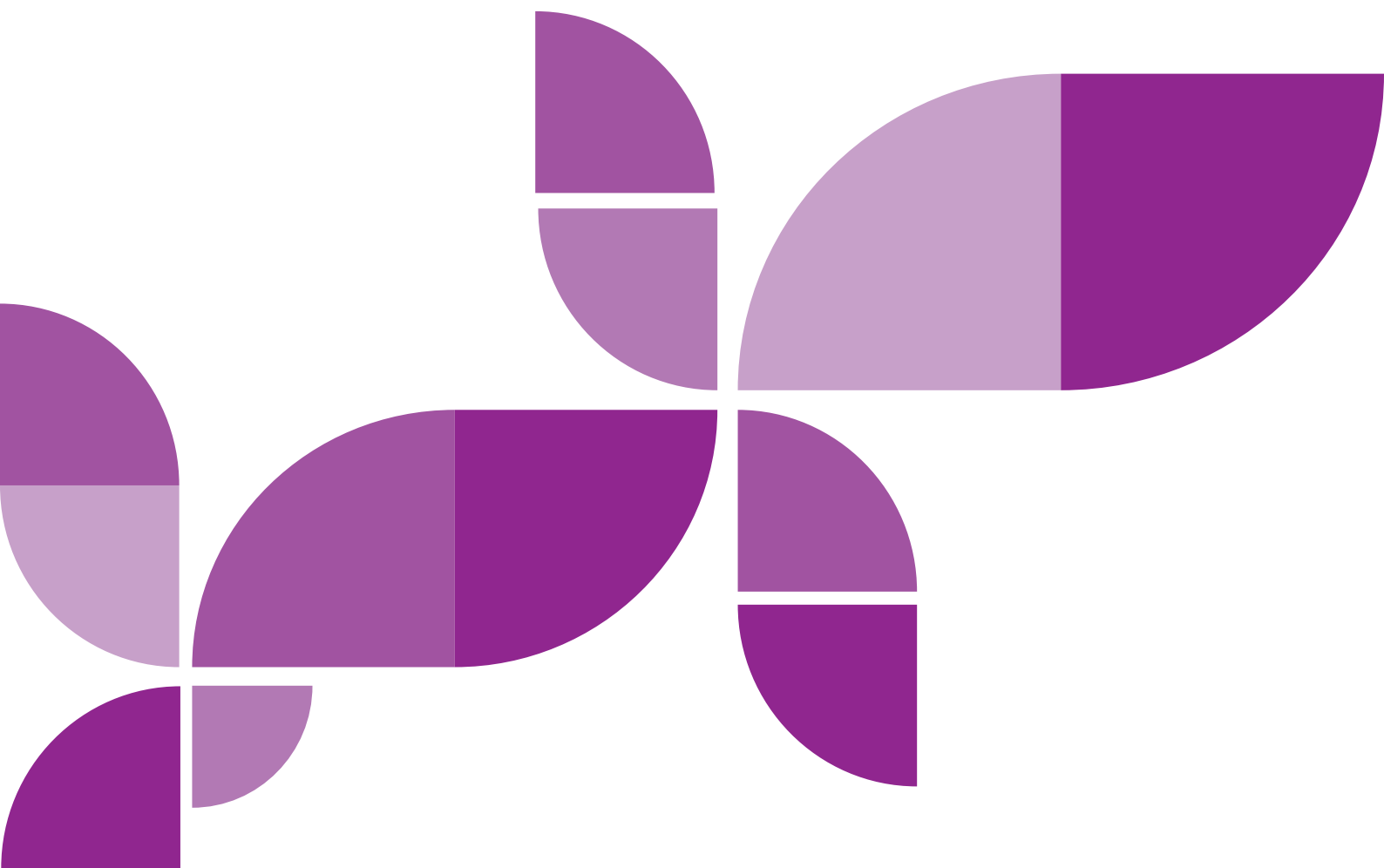
Constructing buildings with blocks and three-dimensional materials and manipulating shapes, such as tangrams and shape pattern blocks are different experiences which allow children to explore and represent the locations of objects in space. Positional words (e.g., on top of, bottom, in front of, behind) can be used as children play in the Block/Construction Centre or in the Dramatic Play Centre to promote their spatial awareness and understanding. For example, when children stack objects, they can talk about the one on top and the one at the bottom to describe their constructed structure. Children can use directional words (e.g., up, down, left, right) as they play physical games, participate in movement activities or play with toys that have the capacity to move, such as cars and trucks. These experiences will help children develop their spatial thinking which lays the foundation for developing higher-order mathematical thinking skills in future learning.

The diagram below shows a possible progression for the learning and development of the concepts of shapes and spatial awareness. The spiral highlights the development that progresses over time and from simple to complex across the concepts and skills. While there is some sequence in which these concepts and skills may be developed, the development does not always take place in a clear or linear manner. Children may develop several concepts and skills at the same time and individual children may move through the concepts and skills in different sequences.



# Chapter 2

## LEARNING GOALS FOR NUMERACY



In the preschool years, it is important to nurture children's interest and disposition for numeracy learning, and focus their learning on essential pre-number, early number, basic shapes and spatial concepts to lay a strong foundation for mathematics learning. Encouraging children to use mathematical language to express and clarify their thinking is also important to help them develop their understanding of numeracy concepts and skills.

The learning goals for numeracy focus on the need for teachers to guide children to:

- Enjoy learning and using numeracy concepts and skills in daily experiences.
- Understand relationships and patterns.
- Develop counting skills and number sense.
- Understand basic shapes and spatial concepts.

The activity ideas or examples in this chapter illustrate how teachers can provide opportunities for children to develop the necessary knowledge, skills and dispositions of the learning goals for Numeracy.

## LEARNING GOAL 1

### Enjoy learning and using numeracy concepts and skills in daily experiences

**Knowledge, Skills and Dispositions (KSD):**  
*Provide opportunities for children to...*

- 1.1 Develop an awareness of how and why numeracy ideas and processes are useful in their daily life
- 1.2 Use mathematical language (e.g., "bigger than", "smaller than", "more than", "fewer than" or "less than", shape names) in their daily life

*Children's learning and development could be observed, for example\*, when they...*

- Enjoy playing numeracy games and reading stories with numeracy-focused themes
- Show interest and participate actively in numeracy activities at the learning centres
- Recognise relationships, patterns, numbers and shapes in the environment and during their daily routines and talk about these with adults and peers

- Use mathematical language to describe or explain their thoughts and ideas (e.g., use “more than”, “fewer than” and/or “less than” when comparing two groups of objects and talk about the attributes used when sorting objects into groups)
- Respond positively and use numeracy concepts/skills to solve problems that they encounter

*The examples are not age-specific or exhaustive. Teachers may provide other appropriate learning experiences/activities based on children's developmental needs and interests.*



Games can ignite and sustain children's interest in learning numeracy.

Children's motivation and interest in numeracy learning can be sustained when they learn through play and recognise and appreciate how numeracy concepts and skills are an integral part of their daily life or experiences. Having a positive attitude helps children feel excited and confident about learning the various numeracy concepts and skills. However, developing this positive attitude towards numeracy learning takes time. Play games, sing songs/rhymes and read books to make learning numeracy enjoyable for children. Seize opportunities that will allow children to see how numeracy is useful and relevant in their daily life. Scaffold and support children's learning so that they can experience success in the various learning activities. These will encourage and excite children in learning and applying numeracy concepts and skills.



## Activity Ideas

### Learning Objective

Children are given opportunities to:

- Recognise and appreciate the usefulness of numeracy concepts and skills in their daily or learning experiences.

Get the children to:

- Organise and keep resources at the learning centres (e.g., coloured paper, coloured pencils/crayons/markers, building blocks, multi-link cubes/chains/counters) by sorting them according to colour, size or shape.
- Draw patterns or use shape cut-outs or craft materials to decorate the borders of photo frames or birthday cards to give to their friends and family members.
- Help to take daily attendance by counting the number of children present/absent for each day.
- Count and collect the number of biscuits they would like to eat for their snack based on their preference or physical needs such as hunger.
- Count and collect the art resources, such as pairs of scissors, bottles of glues, paper and crayons their group needs to do their artwork.
- Play games, such as hopscotch and board games to raise their awareness of how numbers are used in games and practise their counting skill.

## Learning Objective

Children are given opportunities to:

- Identify and talk about numbers, number relationships, patterns and shapes in the environment and daily routines.

Get the children to:

- Go on a neighbourhood walk and identify and describe shapes and patterns observed around them. For example, a child may say, *"I can see a triangle with three equal sides"*, *"The pattern on the zebra crossing is black, white, black, white, black, white"*.
- Go on a garden walk and identify and describe the shapes and sizes they observe on leaves and flowers around them. For example, a child may say, *"The leaves on this plant have a heart shape and are smaller than those found on that tree"*.
- Count and compare the number of legs between insects and spiders and determine which animal has more or fewer legs and state the difference in the number of legs.
- Vote for their favourite book to be read for the day by placing a multi-link cube next to the book of their choice. Join the cubes to make a tower, count and determine which book has the most votes by comparing the heights of the towers made or number of cubes gathered for each book.
- Construct a model of their ideal neighbourhood using recycled materials and describe the locations of the facilities present by using words related to position, direction and distance.
- Work in groups to find out and talk about the different ways to distribute a packet of nine potatoes for two families. For example, the children may say, *"There are nine potatoes in the bag. We will give five potatoes to family A and four potatoes to family B"*.

### DID YOU KNOW?

As numeracy concepts are abstract, teachers play an important role to intentionally model the use of mathematical language consistently in both formal and informal interactions with children to help them understand the use of numeracy concepts and skills.

## LEARNING GOAL 2

### Understand relationships and patterns

**Knowledge, Skills and Dispositions (KSD):**  
*Provide opportunities for children to...*

- 2.1 Match, sort and compare things by at least one attribute (i.e., colour, shape, size, length, height and/or child-determined attributes)
- 2.2 Put things in an order according to attributes (i.e., size, length, height, child-determined attributes and sequence of events)
- 2.3 Recognise, extend and create patterns (e.g., ABABAB, ABCABCABC)
- 2.4 Describe relationships and patterns recognised and created

*Children's learning and development could be observed, for example\*, when they...*

- Identify two objects (e.g., pattern blocks, counters, straws) that have the same colour, shape, size or length and begin to verbally explain what the objects have in common
- Verbally explain why they have paired things, such as a cup and a saucer and a fork and a spoon, or put sets of things together, such as three girls and three baskets
- Sort things in the classroom or environment into groups by one attribute (e.g., colour, shape, size) or two attributes (e.g., colour and shape, colour and size) and begin to verbally explain why the objects are put into the various groups
- Compare two things in the environment by size or length/height and use appropriate comparative vocabulary (e.g., "smaller than", "bigger than", "longer than", "shorter than", "taller than") to describe them
- Put things in an order, such as from smallest to biggest and from shortest to longest, and verbally explain the order

- Order events and activities according to times of the day (e.g., day and night, morning, afternoon and night, breakfast, lunch and dinner)
- Identify, compare and order events in their daily routine, such as breakfast (morning), lunch (noon), snack (afternoon), dinner (evening), sleep (night)
- Order events in sequence of steps from first to last (e.g., steps in a recipe to make a muffin)
- Name and order the days of the week and months of the year
- Recognise and verbally describe repeated patterns in things they see around them, such as fabric, wrapping paper, flower petals and animals like zebras and tigers
- Reproduce a given repeated pattern using objects (e.g., pencil, eraser, pencil, eraser, pencil, eraser) or pattern blocks (e.g., square, circle, triangle, square, circle, triangle, square, circle, triangle)
- Create and verbally describe repeated patterns using objects, words, drawings, symbols or actions

*The examples are not age-specific or exhaustive. Teachers may provide other appropriate learning experiences/ activities based on children's developmental needs and interests.*



Children can practise looking for similar shapes to match in a domino game.

Knowing relationships through matching, sorting, comparing, ordering and patterning are foundational to supporting children's understanding of numbers and the number system. For example, the skill of matching helps children to notice similarities and understand how they can match a picture card of five rabbits to a picture card of 5 carrots as both have the same quantity of 5. The skill of ordering helps children understand the need to recite numbers in sequence and how they can order sets of objects based on quantity. Knowledge of pattern helps children to describe and explain the underlying order that exists in things. Providing experiences for children to identify patterns in their immediate environment and create repeating patterns using colour, shape or size and rhythmic patterns, helps them see relationships, make connections and see the pattern in the number system.

## Activity Ideas

These activity ideas provide opportunities for children to do ordering of objects that are planned in progression from simple to complex.

### Learning Objective

Children are given opportunities to:

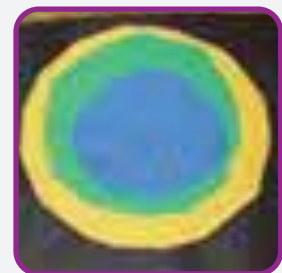
- Put objects in order according to size.

- Have the children use resources such as nesting cups to illustrate how objects could be put in order according to size from smallest to biggest or biggest to smallest by putting them in a row or stacking them.



*Note: If there are children who still have difficulty in grasping the concept of ordering by size, use fewer cups, or use other manipulatives such as the bear family counters for them to arrange by size.*

- Invite the children to show how they would pack and put away the cups and bowls at the Dramatic Play Centre so that the place is neat and tidy (e.g., stacking the cups/bowls/plates by size.)
- Get the children to create an artwork using circle shapes arranged in order of their size. This activity helps to raise the children's awareness of how the concept of ordering is useful and relevant for their art activity.
- Play card games with the children to get them to arrange picture cards with objects according to varying sizes.



## Learning Objective

Children are given opportunities to:

- Put objects in order according to length.

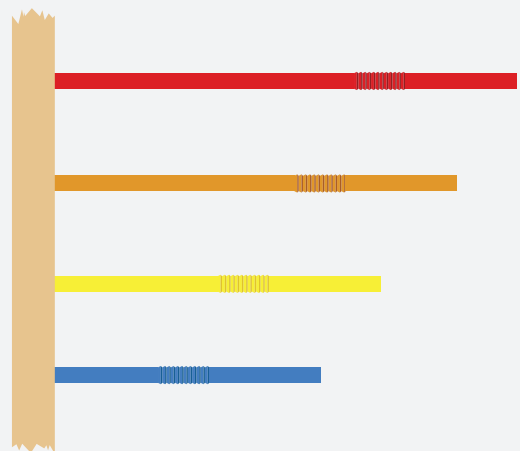
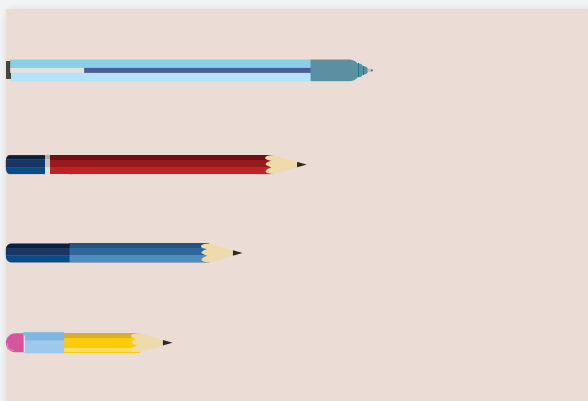
- Bring the children for a walk in the preschool garden or neighbourhood park. Get them to observe leaves of various plants and describe their features, such as colour, size and length. Let them pick and gather leaves found on the ground and compare their length. Encourage the children to describe their findings by using mathematical language (e.g., a child may say, "My leaf is longer than yours.")

- Get the children into small groups and get them to look at the leaves they have collected and show how they can arrange the leaves according to length.

- Provide further opportunities to reinforce the children's learning of the concept of ordering according to length by getting them to put other resources, e.g., pencils, straws, in order from shortest to longest or longest to shortest to find out who has the shortest and longest pencil or straw. **Make sure that the children place their pencils/straws on a common line for comparing the length.**

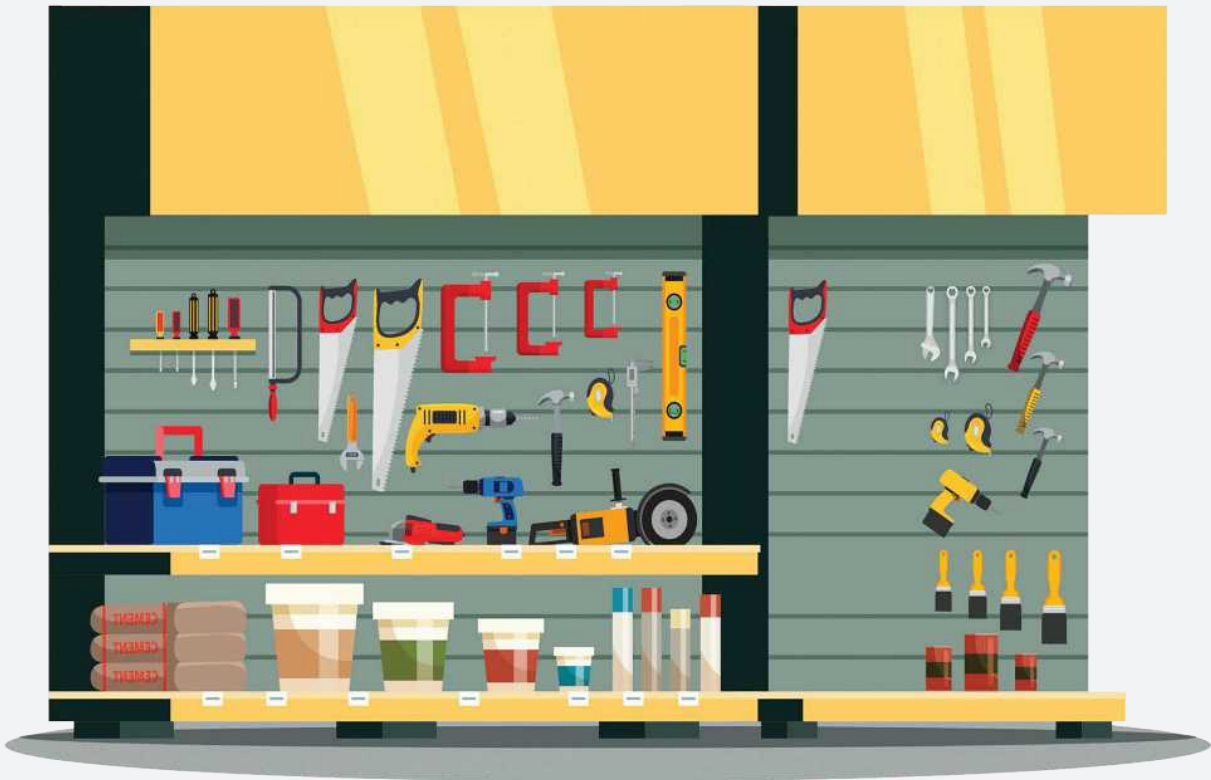
### Note

*Remember to help the children recap their prior knowledge on putting objects in order according to size and make connections to this new learning that things can also be put in an order using length.*





- Play card games with the children to get them to arrange cards with objects of varying lengths.
- Show pictures of shops, such as a hardware shop or a supermarket and get the children to talk about the arrangement of the equipment/goods and the possible reasons for such an arrangement and suggest other ways to arrange the objects.  
Suggested questions:
  - *What do you see in the picture?*
  - *How are the objects arranged? How do you know?*
  - *Why do you think the objects are arranged in this way?*
  - *What other ways can you arrange the objects?*





## Learning Objective

Children are given opportunities to:

- Put objects in order according to height.

- Read books to introduce comparison by height such as “Short and Tall” by Eric Carle.
- Get the children into groups of four and play a game to try to be the first group to find out who is the shortest and tallest child in their group.
- Play card games with the children to get them to arrange picture cards with objects of varying heights.

### Note



*Remember to help the children recap their prior knowledge on putting objects in order according to length and make connections to this new learning that things can also be put in an order using height.*

## Learning Objective

Children are given opportunities to:

- Arrange a series of events in order.

- Demonstrate the steps to prepare a sandwich and let the children follow the steps to prepare their own sandwich for snack. Get them to recall the sequence of the steps by using questions, such as “What did we do first?”, “What was the next step?” and “What was the last step?”
- Read the book, “The Very Hungry Caterpillar” by Eric Carle. Invite the children to recall the sequence of the food that the caterpillar eats, the life cycle of a butterfly and days of the week.
- Help the children relate their learning to their daily life by getting them to arrange photographs of their daily activities and routines in order to show their typical day in school. Then get them to show and describe the sequence of these activities and routines.
- Get the children thematic cards, such as steps for hand washing, getting ready for school and preparing for a field trip.



### Note

- *Select appropriate resources to illustrate and teach the concept of ordering. For example, use pencils, straws, pieces of strings for an activity to order the items by length in order to get the children to focus on the targeted attribute. When comparing length, make sure the children place their objects for comparison at the same starting point to make an accurate comparison.*
- *Model the use of mathematical language in your instructions and get the children to use mathematical language to talk about or describe what they have done.*
- *Help the children make meaningful connections between their prior learning and the new learning. For example, highlight that they can put things in order according to not just size, but also length or height to develop their understanding of using different attributes to put things in order.*
- *Extend the children's learning by providing learning experiences where they can order objects by other attributes, such as shades of colour and thickness after they are familiar with using attributes, such as size, length and height to arrange objects.*

## LEARNING GOAL 3

### Develop counting skills and number sense

**Knowledge, Skills and Dispositions (KSD):**  
*Provide opportunities for children to...*

- 3.1 Rote count to at least 20
- 3.2 Count reliably to at least 10 things
  - 3.2.1 Count things in a collection one at a time (one-to-one correspondence)
  - 3.2.2 Say the number names in sequential order and count up or down from a given number (stable order)
  - 3.2.3 Recognise that the last number counted represents the quantity of things in the set (cardinality)

*Children's learning and development could be observed, for example\*, when they...*

- Say number names in order (e.g., from 1 to 20, 20 to 1) when reciting a rhyme or playing a game
- Touch and count one object at a time when saying the number name (i.e., one-to-one correspondence)
- Count up and count down from a given number (e.g., when children are lining up)
- Estimate how many objects they can see and check by counting them

3.2.4 Recognise that the quantity of a set of things is the same regardless of the starting point of counting (order irrelevance)

3.3 Recognise that the quantity of a set of up to 10 things stays the same regardless of the arrangement (conservation of quantity)

3.4 Recognise numbers in numerals and in words

3.5 Match number name, numeral, and/or number word to the quantity of a set of things

3.6 Write numbers in numerals

3.7 Compare the quantities of two sets of up to 10 things each and use “same as”, “more than”, “fewer than” and “less than” appropriately

3.8 Name the parts that form the whole in a quantity of up to 10 (e.g., 5 is made up of 2 and 3, and 1 and 4)

- Recognise anything can be counted, including claps, beats and steps
- Count and say the same total number of objects presented in different arrangements, such as lines, arrays, circles and random arrangements
- Represent number quantities in a variety of ways (e.g., using objects, fingers, base-10 blocks, ten frames, tally marks)
- Count and say the total number of objects in a set in response to the question “How many are there?” without re-counting
- Recognise and match number names, numerals, and/or number words to the quantity of a group of objects
- Write numerals in a meaningful context (e.g., recording the number of counters on a plate)
- Compare two groups of objects and use language, such as “more than” or “fewer than” to verbally describe that one group is more or less than the other
- Make and read from real object graph (e.g., form two rows of children and compare which row has more children)
- Recognise that a tower of five blocks is made up two red blocks and three green blocks or one red block and four green blocks

*The examples are not age-specific or exhaustive. Teachers may provide other appropriate learning experiences/activities based on children's developmental needs and interests.*



Acquiring counting skills and number sense help children understand the concept of numbers and their relationships.

When children are able to rote count and count reliably, they will be able to find the answer to “*How many are there?*” Their ability to count accurately and tell “how many” is an important first step towards an understanding of numbers. They will then need to move beyond counting and develop their number sense, which includes the ability to understand the concept of quantities, such as “more” and “less”, conservation of number and part-whole relationships. In other words, children must be provided with meaningful opportunities to think about and recognise how numbers relate to one another, such as 5 is 1 more than 4 and 1 less than 6, and 5 is made up of 2 and 3 or 4 and 1. Numerals should be introduced in association with the quantities that they represent so that the numerals, which are symbols, will have meaning for children as visual images of the quantities they represent. Early experience with numbers is fundamental for acquiring more complex numeracy concepts and skills.

## Activity Ideas

The number '5' is used in these activity ideas to provide opportunities for children to develop their counting skills and number sense up to 5 that are planned in progression, from simple to complex. Note that the progression shown below should be applied to all the numbers taught in order for children to develop a full conceptual understanding of each number.

### Learning Objective

Children are given opportunities to:

- Rote count from 1 to 5.

- Get the children to sing a number song or rhyme with actions. For example, recite an adapted number rhyme, "Here is a Beehive".

**Here is a beehive.**

*(make a fist)*

**But where are all the bees?**

**Hiding inside where nobody sees.**

**Here they come flying.**

**Out of the hive.**

**1, 2, 3, 4, 5.**

*(count aloud and release one finger  
at a time)*

**BUZZ-ZZZZZZZ!**

### DID YOU KNOW?

- Songs and finger rhymes with actions provide the children with opportunities to say/sing the number names in a sequential order. It also allows the children to practise their one-to-one correspondence skills as they say the number name and show their fingers together when reciting the rhyme.
- The same song/rhyme can be adapted and used to introduce subsequent numbers to help the children see the relationship between the new number introduced and previous number learnt.

## Learning Objective

Children are given opportunities to:

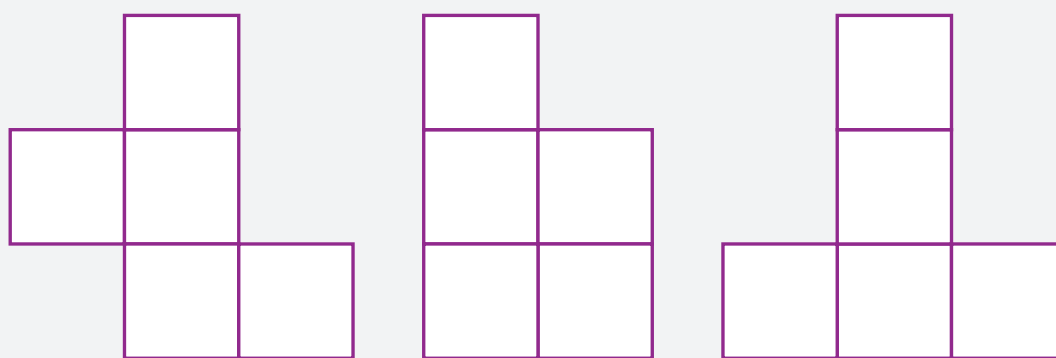
- Count reliably up to five things.

- Show children things that come in fives, e.g., hibiscus and periwinkle flowers with five petals.



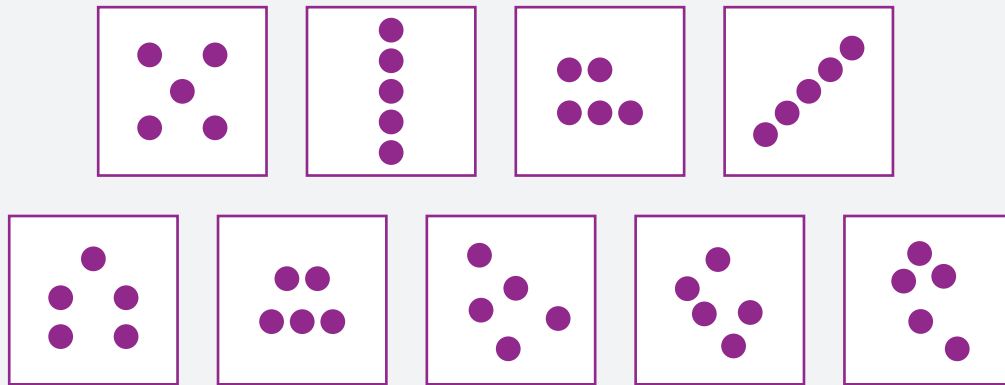
- Invite the children to describe the flowers and prompt them to focus on the petals by asking them questions, such as “*Can you tell me more about the petals?*”, “*How many petals can you see on the flowers?*”, “*How do you know there are five petals?*” and “*Can you show me?*”
- Show more examples of other things that come in fives for the children to count reliably, e.g., 5-pointed stars, fingers on one hand, toes on one foot.
- Invite the children to count and bring five objects found in the classroom (e.g., crayons/pencils/markers, scissors, paintbrushes, books).
- Provide the children with other materials for them to practise counting reliably up to five things. For example,
  - Get the children to count objects in a set such as several plates of five counters. Ask the children, “*How many links/unifix cubes/bear counters are there on this plate?*”. Allow them to count the counters in each plate by moving each counter to an empty plate to help them to keep track of what have been counted and what have not been counted.
  - Get the children to count reliably by placing each counter counted in a box on a template (see examples below). This is to help them focus on the concept of one-to-one correspondence when counting.





- Get the children to count from a large collection of objects. For example, ask them to choose five chain links of their favourite colour from a tray of links to make a bracelet.
- Invite the children to count five objects printed on a picture card where they can only touch these objects but not move them as they count.
- Read a book with illustrations of things for the children to explore counting from different starting points to help them understand that the quantity of a set of things is the same regardless of the starting point. For example, ask the children, “*How many frogs are in the pond?*”. Invite a child to point and count the frogs in the picture. Then invite other children to check the answer by counting from different starting points.
- Design a hopscotch game with five squares for the children to hop and count up to and count down from five.
- Get the children to close their eyes and count the number of counters/objects being dropped into a tin by listening to the sounds.
- Use daily routines and transitions to provide concrete experiences for the children to practise counting reliably. For example,
  - Get the children to count the number of children in their own group in order to collect the right number of materials for an activity.
- After various counting experiences of using touch, sight and hearing, provide opportunities for the children to determine the quantities in groups of things without touching the things as they count. Such experiences will allow them to recognise a quantity instantly without counting and form mental images of certain quantities. This ability to group and quantify groups of things quickly (i.e., subitising) supports the children’s development of number sense. To help children develop this skill:

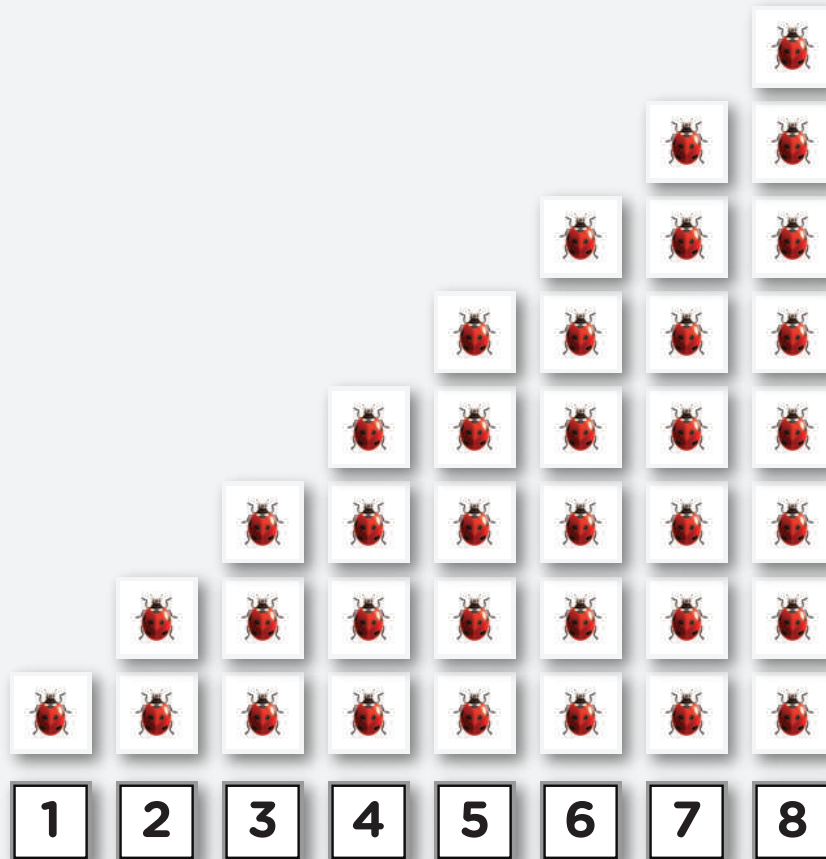
- Arrange varying quantities of pegs in different arrangements on a pegboard and ask the children to identify sets of five pegs.
- Prepare dot cards of various quantities in different arrangements. Ask the children to pick cards that show five dots. Below are examples of dot cards for the number '5' in different arrangements:



## Learning Objectives

Children are given opportunities to:

- Recognise and match numeral '5' to the quantity of a set of objects.
  - Recognise and match number word 'five' to the quantity of a set of objects.
- 
- After various counting experiences, scaffold the children's understanding in connecting the numeral and number word to the quantity. For example, get them to play a finger counting game. Call out any number from one to five and get them to show the correct number of fingers on one hand. Introduce number '5' by showing the numeral and number word. Point to the numeral and number word shown to explain that they represent the number '5'. Have the children write number '5' in the air.
  - Use a number line to help the children understand the sequence and order of numbers. For example, introduce number '5' using the same pictorial representations (e.g., ladybirds) arranged in alignment and order to help the children see that 5 is 1 more than 4 and later on, that 5 is 1 less than 6.



### Note

*Do ensure that the pictorial representations used for the number line are consistent in shape, size and colour so that the children can better understand how one number is related to another in terms of quantity. Placing the picture cards in alignment and order on the number line raises the children's awareness of the increasing quantity as a larger number is introduced.*



### Learning Objective

Children are given opportunities to:

- Write numbers in numeral.
- Have the children form the numeral for '5' using playdough.
- Provide opportunities for the children to write the numerals when appropriate and in a meaningful context, e.g., recording scores for a game.

**The number '5' is used in these activity ideas to provide opportunities for children to compare the quantities of two sets of things that are planned in progression, from simple to complex.**

### Learning Objective/s

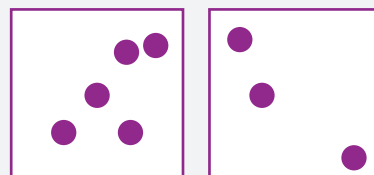
Children are given opportunities to:

- Compare the quantities of two sets of up to five things and use “same as”, “more than” appropriately.
- 
- Show the children numeral cards from one to five, one at a time. Ask them to show their fingers for each card to tap on their prior knowledge of counting reliably up to five things and matching numerals to the quantities.
  - Invite the children to use their fingers to show their favourite numbers from one to five. Get them to show the number of fingers to their partner and compare who has more fingers. Model the use of mathematical language, such as:
    - *Pauline is showing five fingers.*
    - *Arif is showing three fingers.*
    - *Who is showing more fingers?*
    - *Pauline shows more fingers than Arif.*
    - *5 is more than 3.*
  - Get the children to work in pairs to compare two sets of counters to find out who has more counters and why they think so. Choose appropriate resources, such as interlocking cubes and penguin counters with ice bar (see example shown below) to facilitate their learning on how they can compare two sets of objects by putting them side by side vertically or horizontally. For example:
    - Provide each child with a set of numeral cards from 1 to 5.
    - Provide Child A with five penguin counters of the same colour and an ice-bar, and Child B with five penguin counters of a different colour and an ice-bar.
    - Get each child to shuffle their numeral cards and place them on the table facing down.

- Ask each child to pick a card and place the corresponding number of penguin counters on his/her ice-bar.
- Get both children to place their ice-bars side by side as shown below to compare and decide which ice-bar has more penguin counters.



- Guide the children to use mathematical language to explain by saying, *"I have four red penguins. You have three white penguins. I have more penguins than you. Four is more than three."*
- Provide the children with opportunities to compare two sets of counters in random arrangement. For example:
  - Get each group to play a game of "Count and Compare".
  - Provide each child with a set of dot cards from 1 to 5.
  - Get them to each pick a card to find out whose card has more dots and why they say so.
  - Encourage the children to share their ways of finding out their answers.
  - Model the use of mathematical language by saying:
    - *My card has five dots.*
    - *Your card has three dots.*
    - *My card has more dots than your card.*
    - *5 is more than 3.*
- Reinforce the children's learning across different contexts. For example, get them to compare the number of biscuits they have during snack time and ask them who has more and why some of their friends have more biscuits (e.g., because they are hungry, because they like the biscuits today) or the number of successful catches during a ball tossing and catching game.





### Note

- *As comparison of numbers is the foundation for understanding operations, such as addition and subtraction, provide ample opportunities for the children to compare quantities between sets of things.*
- *Once the children are able to use “same as” and “more than” appropriately when comparing quantities, progress to activities for them to compare quantities and explore using “fewer/less than” appropriately.*
- *After the children are able to compare and identify which set has more or fewer things, they can begin to determine the difference between two sets of things.*

**The number ‘5’ is used in these activities to provide opportunities for children to name the parts that form a whole which are planned in progression, from simple to complex.**

### Learning Objective

Children are given opportunities to:

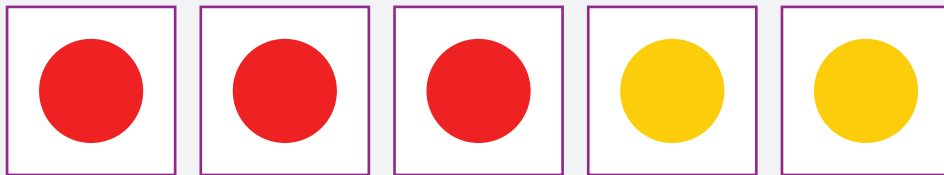
- Identify the parts that make ‘5’.
- 
- Get the children to play a movement game to reinforce their understanding of the number. Play some music and get them to do different movements, such as walk, skip and hop. Once the music stops, the children will have to form a group of five children. This is to tap their prior knowledge of counting reliably up to five things. Ask the children to talk about their group by asking them, “*Do you have five children in your group?*”, “*Who are the five children in your group?*”, “*How many are boys?*” and “*How many are girls?*” Model the use of mathematical language by saying:
    - *There are five children in the group.*
    - *Two are boys.*
    - *Three are girls.*
  - Tell a number story using objects, such as cars and a counting board to represent the setting for the story such as a road scene. Model the use of mathematical language to tell the story. For example, say, “*There are five cars on the road. There are two blue cars and three red cars.*”



- Use resources, such as interlocking cubes, dual-coloured counters and number bracelet, for the children to explore decomposing a quantity of five things. This will help them understand that 5 can be made up of 2 and 3, and 1 and 4. For example:

### Using dual-coloured counters

- Give each child five dual-coloured counters and play a tossing game.
- Get the children to toss the counters and invite a few children to answer the following questions:
  - *How many counters are there?*
  - *How many of them are red?*
  - *How many of them are yellow?*
- Based on the children's responses, record the various combinations on the activity strips (see picture below).



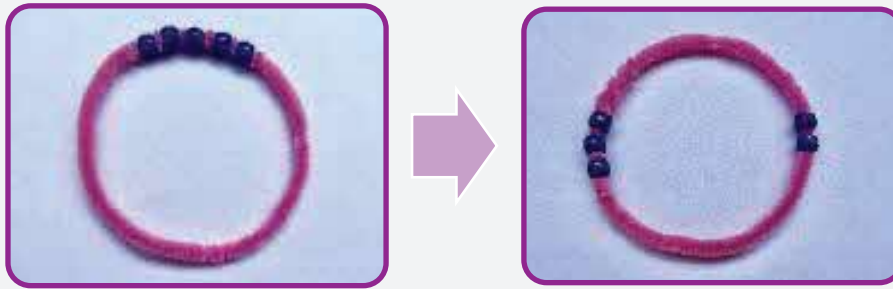
- Model the use of mathematical language to describe the part-whole relationship by stating the whole followed by the parts:
  - *There are five counters.*
  - *Three are red and two are yellow.*
- Point to the various combinations on the activity strips to highlight that 5 can be made up of 2 and 3, 3 and 2, 1 and 4, and 4 and 1.

### Using number bracelet

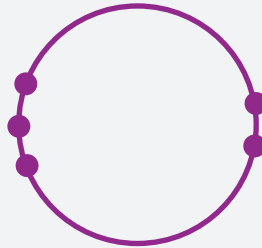
- Give each child a pipe cleaner and a small plate. Invite the children to pick five beads from a bowl to place on their plate. Get them to string the beads onto the pipe cleaner to create a bracelet consisting of five beads as shown in the picture.



- Get the children to close their eyes and move the beads to separate them into two parts. For example:



- Get them to draw the separated beads on the bracelet and write the numerals on an activity sheet as shown below:



There are 5 beads on my bracelet.

How many beads are on my left?	How many beads are on my right?
3	2

- Record the children's answers and highlight the different ways of decomposing/ breaking up the number '5' (i.e., 5 can be made up of 2 and 3, 3 and 2, 1 and 4, and 4 and 1.)
- Reinforce the children's learning during routines and transitions. For example, engage them in a finger play during arrival or departure time to explore using their fingers on both hands to show the different parts to make '5'.

### Note



- *Part-whole relationship is the understanding that a number can be split into parts, which will help the children with addition and subtraction in their future learning.*
- *Provide the children with many opportunities to help them understand that any whole number can be represented in two or more parts.*

## LEARNING GOAL 4

### Understand basic shapes and spatial concepts

**Knowledge, Skills and Dispositions (KSD):**  
*Provide opportunities for children to...*

- 4.1 Recognise the four basic shapes (i.e., circle, square, rectangle and triangle)
- 4.2 Develop an awareness of the attributes of the four basic shapes
- 4.3 Use the basic shapes to form other shapes or figures
- 4.4 Develop an awareness of spatial concepts, such as position (i.e., top and bottom, in front of and behind), direction (i.e., up and down, left and right) and distance (i.e., far and near)

*Children's learning and development could be observed, for example\*, when they...*

- Recognise and name the four basic shapes in their classrooms and immediate environment
- Identify and describe the shapes based on their attributes (e.g., a triangle has three sides, a square has four equal sides)
- Recognise shapes of different sizes and orientations in a picture
- Make figures using basic shapes (e.g., use two squares and one triangle to form a boat)
- Use words, such as “top” and “bottom”, and “in front of” and “behind” to describe the position of an object
- Use words, such as “left” and “right” and “far” and “near” to describe direction and distance of objects
- Respond appropriately when asked to move to the right and/or left position

*The examples are not age-specific or exhaustive. Teachers may provide other appropriate learning experiences/activities based on children's developmental needs and interests.*

*I am going to make a triangle. I pull the rubber bands to make three sides.*



Provide ample opportunities for children to explore shapes in a variety of ways to develop and reinforce their conceptual understanding of the four basic shapes.

Knowledge of basic shapes helps children to differentiate and describe things in the environment. Understanding simple spatial concepts helps them to be aware of and to represent the relationship between objects and places around them. Children should be provided with ample opportunities to manipulate, draw and represent shapes in a variety of ways to help them understand the concept of basic shapes. These opportunities could include working with shapes in art and craft activities and constructing shapes with pattern blocks, which will help them to identify the various shapes and describe and differentiate them by their attributes.

When children explore the individual shapes, they also begin to learn to use two to three shapes to make other shapes or figures. Children should also be provided with opportunities to develop an understanding of a variety of spatial concepts, such as position, direction and distance. Children's understanding of basic shapes and spatial concepts will lay the foundation for their future learning about geometry which involves shape, size, position, direction and orientation.

## Activity Ideas

The square shape is used in these activity ideas to provide opportunities for children to know about basic shapes and how to use basic shapes to form a new shape or figure that are planned in progression, from simple to complex.

### Learning Objectives

Children are given opportunities to:

- Recognise and name the square shape.
- Identify and describe square shape based on its attributes (e.g., a square has four equal sides).

- Get the children to look around in their classroom, outdoors or during a neighbourhood walk to identify things that are square in shape. Get them to talk about how they know that these things are square in shape. Help them be aware that things around are made up of different shapes and these can also come in different sizes.
- Have the children make a “Shape Book” by searching for and using pictures from magazines and newspapers of things that are square in shape. Then get them to show and talk about the squares in their book. Model the use of mathematical language to describe a square by saying, *“This is a square. It has four sides, and all the sides are the same.”*
- After the children are able to recognise and describe the attributes of a square, provide opportunities for them to create square shapes using different materials (e.g., playdough, pipe cleaner, craft sticks).
- Invite the children to work with their friends to explore ways to use their body or parts of their body to form a square shape. Take photographs of their body shape formations and invite the children to talk about how they have formed the square shape and suggest ways to improve.
- Choose appropriate resources, such as rubber bands and geoboards for the children to create square shapes in different sizes on a geoboard.

## Learning Objective

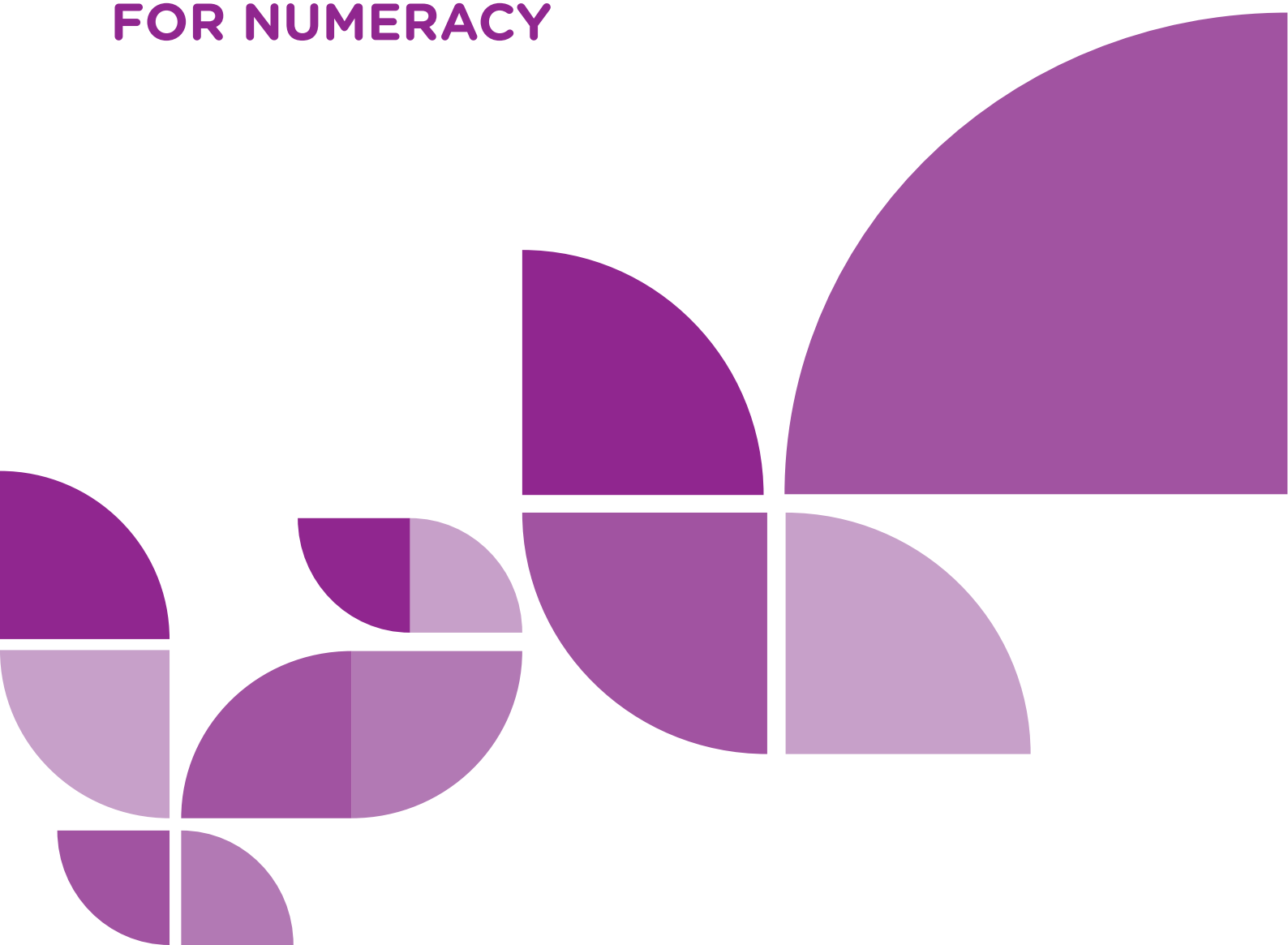
Children are given opportunities to:

- Use square shape to form other figures.
- 
- Get the children to explore forming figures using square-shaped pattern blocks (e.g., use two squares to form a rectangle or several squares to form a block of flats).
  - Provide the children with five small-coloured square pieces of paper to form a figure on a piece of paper. Have them do a “Show and Tell” to talk about the figure they have created. Help them be aware that different figures can be created from the square pieces of paper.



# Chapter 3

## STRATEGIES FOR NUMERACY





**Child A:** *Teacher, I picked many leaves that are longer than yours.*

**Child B:** *My leaf is shorter than yours.*

**Teacher:** *That's good! Some leaves are long, and some leaves are short. Let's compare and find out if you are correct.*

Modelling the use of mathematical language during daily interactions with children help them see that numeracy is all around us.

Numeracy is all around us. The learning of numeracy can be embedded in children's daily routines, play and across the different learning experiences created for them. It can also be done through hands-on activities planned by the teacher, which can range from individual to small and large group activities to extend the discussion and application of numeracy concepts and skills with children. By using prompts, asking questions and having conversations with children, teachers provide opportunities for children to think and talk about the various numeracy concepts and skills throughout the day, as well as reinforce the use of mathematical language and promote joy and interest in numeracy learning.

Strategies that encourage the learning of numeracy concepts and skills include:

- Using Concrete-Pictorial-Abstract Approach
- Using manipulatives and games
- Using stories, songs and rhymes
- Asking prompting questions
- Providing opportunities for problem solving
- Using daily routines and transitions

## USING CONCRETE-PICTORIAL-ABSTRACT APPROACH

As numeracy concepts are abstract, the Concrete-Pictorial-Abstract (CPA) approach provides a structure to guide teachers in planning learning experiences that use physical and visual aids to help children develop their understanding of these concepts.

The CPA approach helps children to learn about the numeracy concept and skill by moving from using concrete and familiar materials to pictorial representations of concrete objects before progressing to using abstract symbolic representations. Teachers should help children see and understand the connections between the concrete, pictorial and abstract phases by planning learning experiences for children to go back and forth between each of the phases.

At the **concrete phase**, children are introduced to the new concept/skill with the use of concrete objects (e.g., manipulatives or real familiar objects) or guided to uncover the abstract numeracy concept/skill during their daily learning experiences, such as outdoor learning, learning centre time and routines and transitions (e.g., counting the number of biscuits that they have for their snack, ensuring they count and complete the eight steps of proper handwashing). At the **pictorial phase**, images/pictures that represent the concrete objects or daily learning experiences are used to reinforce children's understanding of the concept/skill being taught. This phase acts as a bridge between the concrete objects that children have been using and the abstract symbolic representations that they will learn to use. At the **abstract phase**, the use of words and symbols (e.g., numerals and number words) help children to gain mastery of the concept/skill and allow them to use more abstract ways to represent and communicate mathematical ideas.

Teachers play an important role in facilitating and guiding children through the concrete, pictorial and abstract phases of understanding by providing appropriate scaffolding and feedback. It is important to note that to help children build and deepen their conceptual understanding, teachers will need to vary the resources used within each phase so that children have different hands-on experiences to construct meaning and deepen understanding of the concept and skill under different contexts. For example, let children explore sorting different resources, such as a variety of counters during learning centre time and leaves, twigs or stones found during a garden walk, using different attributes (e.g., colour, size, shape). To extend their learning, children should also be given the opportunity to think of and use other possible attributes to sort the given resources they have or explore sorting by two attributes at the same time.

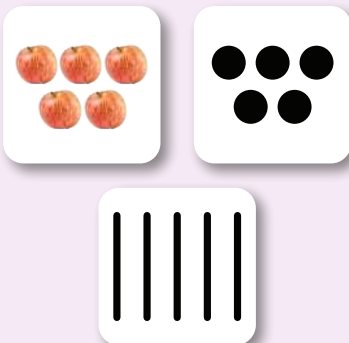
The example below illustrates the teaching of number '5' using the CPA approach:

### Concrete



- Model counting using concrete or real objects.
- Have children count the objects by touching and moving them one at a time from one place to another as they count them (e.g., from one tray to another tray) to help them keep track of the counted and uncounted objects.
- Provide other counting experiences, such as counting objects that are at a distance where children can see but cannot touch them and counting objects from the sound they make when dropped into a tin.

### Pictorial



- Model counting objects represented in a pictorial form after children have developed a full understanding of counting reliably at the concrete phase.
- Provide opportunities for children to draw pictures or make marks of the objects counted.
- Provide further opportunities for counting at the pictorial phase by using other visual representations, such as dots or tallies where children can touch but not move them.

### Abstract

**5**  
five

- Use symbols or words, such as numerals or number words to represent the number of objects counted at the concrete and pictorial phases.

## USING MANIPULATIVES AND GAMES

### Manipulatives



Manipulatives allow children to learn numeracy concepts such as part-whole relationship through hands-on experiences.

Studies have shown that using manipulatives meaningfully helps children to better grasp the numeracy concepts. Teachers must choose appropriate manipulatives and use them to support children's learning of the numeracy concepts and skills with guidance and scaffolding. For example, use multi-link cubes of different colours to allow children to focus on colour, which is used as an attribute to sort the cubes; use same colour pattern blocks to allow children to focus on shape, which is used as an attribute to sort the blocks; and use the bear family counters to allow children to sort the counters by using different attributes, such as colour or size.

### Games

Games make it more interesting and enjoyable for children to practise and extend numeracy skills. These can be conducted both indoors and outdoors, providing opportunities for children to reinforce their learning of numeracy concepts and skills. Examples of outdoor games may include hopscotch where children practise their counting skills and a scavenger hunt where children look for shapes or patterns in their environment. Examples of indoor games may include board games, dominoes, bingo and matching card games which are enjoyable ways for children to learn and apply numeracy concepts and skills.

It is important that teachers observe children during the game and listen to them so as to understand their thinking to monitor and assess the progress of their learning of the concepts and skills. For example, as a child moves a game piece along a path in a board game, teachers can observe whether the child can recite the number sequence accurately and maintain one-to-one correspondence to count reliably.





**Teacher:** *What is the number on the die?*

**Child:** 2!

**Teacher:** *What number must you roll next to reach the finishing point?*

**Child:** 1, 2, 3, 4.

**Teacher:** *Four more squares to reach the finishing point!*

Teachers can observe and assess children's progress in developing counting skills during a board game.

When children count pictures of objects, squares on a board game path, or dots on a die in a game, they experience counting in a variety of different settings which helps them move from the “moving each object” stage, where they can keep track of the objects counted, to a stage where they can touch but cannot move the objects as they count. This is an important skill where they will need to remember objects they have counted and not count them again to get the correct answer. Games with dot cards provide children with opportunities to practise counting and subitizing where the use of a variety of dot arrangements helps them develop different mental images of quantities.

**Games also help children exercise and enhance their executive functioning skills.** Children practise their inhibitory control skills when they are engaged in games that require them to focus and wait for their turn and/or think before they act. For example, teachers can get children to follow a pattern of actions such as clap twice and pat each elbow once. In such games, children learn to remember and repeat the pattern, as well as wait for their turn. Other games such as matching card games allow children to use and improve their working memory as they are required to hold multiple pieces of information in their mind, i.e., the pictures on the cards that had been turned over and the matching cards they turn over when it is their turn. Solving jigsaw puzzles or playing a lotto or bingo game that requires children to mark a card with the opposite of what is called out, promotes cognitive flexibility. When children play games with their friends, they also develop social and emotional skills, such as taking turns, being patient and playing cooperatively, as well as learning dispositions, such as perseverance and engagement.



## USING STORIES, SONGS AND RHYMES



**Teacher:** *Can anyone show me with your fingers what other shape can the mouse build its house with?*

**Children said,** *Triangle!* and used their fingers to show the shape of a triangle.

**Teacher:** *Can the mouse use another shape to make the house? What shape can it be? Why do you say that?*

Stories can be used to set meaningful contexts for the learning and understanding of numeracy concepts/skills.

Stories can be used to develop and review numeracy concepts, pose a problem, demonstrate the use of numeracy concepts/skills and introduce vocabulary associated with the numeracy concepts. A number of studies have found that storybooks can be an effective way for contextualising numeracy instruction that supports children's learning (Biemiller & Boote, 2006; Luedtke & Survang, 2017; Horst et al., 2011). Stories can engage and motivate children to actively discover and develop numeracy concepts and skills in a more meaningful and interesting way that will nurture in them a positive attitude towards numeracy teaching and learning (Saracho & Spodek, 2009).

Picture books should be carefully selected with contents and illustrations that accurately portray the targeted numeracy concept/skill (e.g., numbers, counting, shapes and spatial concepts). Books with interesting storylines will engage children and can stimulate their thinking. For example, books which describe the attributes of different shapes and illustrate the shapes in various positions and sizes can help children deepen their understanding of shapes and spatial awareness. After using a book to teach a numeracy concept, it should be left at the Reading Centre for children to revisit the story independently or with a friend/teacher.

Teachers can facilitate story telling by using a variety of prompts or questions to lead to or focus on the numeracy concept(s) covered in the story. For example:

### Type and Purpose of Prompts/Questions

Use prompts/questions or point out words and pictures that depict the numeracy concept(s)/ skill(s) in the story.

Ask questions that do not have a single correct answer.

Ask questions to help relate the numeracy concept to children's daily life or encourage children to make predictions.

### Examples of Prompts/Questions

- *Look, there are three bears in the house. Show me how to write number '3' with your fingers.*
- *Which day of the week comes next?*
- *What is that shape that is used for the roof of the house? How do you know?*
- *Look! Here's a red bird and then a blue bird. What do you think comes next?*
- *Who has picked more seashells? How do you know?*

- *What is a shorter route for the ants to reach their home?*
- *Tell me how the girl could give her friend five of her chocolate and butter cookies.*

- *What did the children do to get ready to go to school? How are the things they do the same or different from you? What do you normally do to get ready for school?*
- *Can you find two things on this page that you also have in your room? What do you use these two things for?*
- *What will happen if the boy moves nearer to the river?*



The teacher asks questions like:

- *How many oranges did the caterpillar eat? Show me with your fingers?*
- *What number do you think comes next? How do you know?*

A variety of questions or prompts can be used during story telling to help children develop and review their learning and understanding of numeracy concepts and skills.

Songs and nursery rhymes can also be used to make learning of numeracy concepts and skills more relevant and enjoyable. Singing songs or reciting rhymes with actions, such as “The Ants Go Marching”, “Once I Caught a Fish Alive”, “Five Little Monkeys Jumping on the Bed”, “Five Little Ducks Swimming in a Pond” and “One, Two, Buckle My Shoe” allow children to develop and practise their counting skills.

## ASKING PROMPTING QUESTIONS

Numeracy learning can occur throughout the day, such as during routines and transitions, play and outdoor learning when teachers can talk to children about numbers, counting, comparing sizes, shapes, positions and directions. Teachers can use a variety of prompts and questions to engage children in discussions about numeracy ideas and strategies, get them to talk about how they have completed a task or solved a numeracy-related problem. Such experiences and opportunities created for children enable them to reflect on their thinking process (i.e., metacognition) and strategies used, learn from their mistakes and further develop

### DID YOU KNOW?

From children’s responses, teachers can gain insights into children’s thinking process. The following three examples of children’s responses to the questions, “*How many cubes are there?*” and “*How do you know?*” show their thinking about numbers:

- *There are five cubes. I counted them - 1, 2, 3, 4, 5.* [Shows that the child is able to count reliably.]
- *It’s five cubes. There are four cubes and one more.* [Shows that the child is able to name the parts that 5 is made up of.]
- *It’s five cubes. I know it is five.* [Shows that the child is able to subitise.]



their problem-solving skills. Teachers should also use mathematical language or vocabulary intentionally and meaningfully in their daily formal and informal interactions with children to help promote and extend their thinking.

There is a wide variety of contexts in which prompting questions for numeracy development can be asked, such as during daily routines (e.g., “*How many biscuits did you put on your plate?*” during snack time) and planned activities (e.g., “*What is the pattern that you have created for your bracelet?*” at the Art and Craft Centre).

The tables below provide examples of questions that teachers can use to scaffold children’s learning of new concepts or extend their thinking and understanding.

During a sorting activity, teachers may consider facilitating children’s learning by asking the following questions:



- *How can/did you sort these objects?*
- *Why did you sort the objects this way?*
- *How are they alike? How are they different?*
- *What other ways are there to sort these objects?*

During a patterning activity, teachers may consider facilitating children’s learning by asking the following questions:

- *What comes after this/next/before this ...? How do you know?*
- *What pattern did you create? Tell me about your pattern.*
- *What other patterns can you create?*



During a counting activity, teachers may consider facilitating children's learning by asking the following questions:



- *How many ducks are in the pond?*
- *What number comes before/after 6?*
- *What are the missing numbers?*

During daily routines such as choosing their favourite book to be read, teachers may consider facilitating children's learning on comparison of numbers by asking the following questions:

- *How many votes does Book A have?*
- *How many votes does Book B have?*
- *Which book has more votes?*
- *How many more votes does Book A have than Book B? How do you know?*



During learning centre time, teachers may consider facilitating children's learning on creating basic shapes by asking the following questions:



- *I am thinking of a shape that has three sides. Can you make that shape?*
- *How is your triangle different and how is it the same as your friend's triangle?*
- *How many triangles can you create on the geoboard with two rubber bands?*
- *What shape can you make if you place the two triangles next to each other?*
- *Can you create any unusual shapes?*

## PROVIDING OPPORTUNITIES FOR PROBLEM-SOLVING

Children should be given opportunities to explore numeracy concepts and ideas and come up with strategies to solve puzzles or problems they encounter in their daily experiences. For example, teachers may get them to suggest ideas for the following situations:

- Arranging the building blocks on the shelf in a way that will help them to find the blocks they need quickly for construction play
- Keeping the stationery and craft materials neatly at the Art and Craft Centre
- Arranging the books at the Reading Centre in a way that will allow them to look for the book they want easily

### Four useful steps to facilitate the process of problem-solving:

#### Step 1

##### **Understand the problem**

Children have to understand the problem they are trying to solve.

#### Step 2

##### **Devise a plan**

When children understand what the problem is, they can think of ideas and strategies to solve the problem and devise a plan to reach that goal.

#### Step 3

##### **Carry out the plan**

When children have selected a strategy and made a plan, they can carry it out to find the solution to the problem.

#### Step 4

##### **Look back**

When children have completed their work, they can think back and explain the solution or how they have solved the problem and suggest if there are other ways to solve the problem.



**An example of problem-solving by children:****Situation:**

To enable the children to find the building blocks they need easily for construction play

**Step 1: Understand the problem**

Children have to recognise that the Construction/Block Play Centre is in a mess and they are having difficulties finding the building blocks they need to construct their structure. They will need to identify the problem and possible causes.

**Step 2: Devise a plan**

Once the children have identified and understood the problem, they can start to think of ways to organise the building blocks that will help them find the blocks easily and quickly. They can make a drawing of their plan to help them in their implementation.

**Step 3: Carry out the plan**

The children arrange the building blocks based on their plan. They then find out whether their arrangement by ordering the blocks by size/shape or sorting the blocks by colour helps them to locate the blocks easily.

**Step 4: Look back**

The children share their experience at the Construction/Block Play Centre and any challenges they still face in finding the blocks they need to build their structures. Invite them to share other possible ways to arrange the blocks that will help to further improve the situation.

When children encounter difficulties in solving a problem, teachers should not provide the solution immediately but instead, give timely support and guidance by asking prompting questions to encourage them to consider other ways, such as “*Why don’t you try to do it differently?*” or “*How about doing it in another way?*”. Give children positive feedback by acknowledging their effort in trying to solve the problem, encouraging them to keep trying and inviting them to share how they have solved the problem, to foster the learning dispositions, perseverance, inventiveness and reflectiveness in children.

## USING DAILY ROUTINES AND TRANSITIONS

Teachers should provide and seize opportunities throughout the day to support and reinforce children's numeracy learning, e.g., taking attendance during arrival, stating the date and talking about the sequence of their daily schedule, voting for their favourite book to read, sorting their play materials when cleaning up, recording and comparing scores during a game.



**1,2,3,4,5,6,7,8.**  
There are eight steps to wash my hands clean.

Daily routines and transitions in the preschool centre offer good opportunities for children to apply numeracy concepts and skills in a meaningful context.

Below are some examples of ways teachers can engage children in practising numeracy concepts and skills during their daily routines and transitions.

### Daily attendance taking

Ask children e.g., "How many boys are there in this class? How many girls are there" Then proceed to ask, "Are there more boys than girls?", "How do you know?" and "How would we know the total number of children here today?"

### Cleaning-up

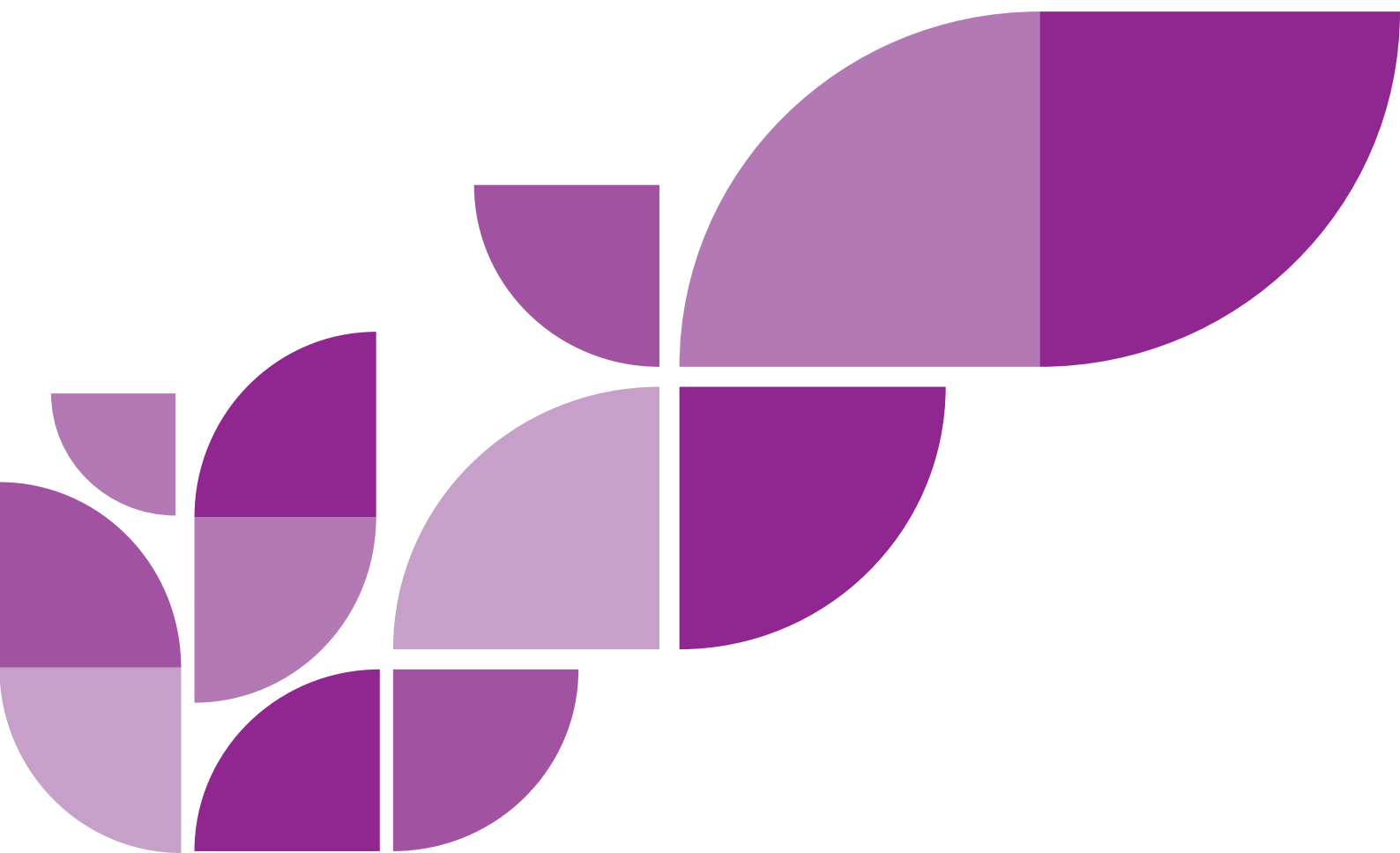
Clap in a rhythmic pattern to signal that it is clean-up time. Describe the pattern by saying, "That was three loud claps, then two soft claps. Get ready to clean up!" Have children introduce another rhythmic pattern for the following day's clean-up time.

### Reading on arrival or before dismissal

Have children vote for the book they would like to read. Count the votes and write the corresponding numerals for the children to compare which book has more votes.

# Chapter 4

## ORGANISING THE LEARNING ENVIRONMENT



The organisation of the learning environment in terms of the physical, interactional and temporal aspects has an impact on children's behaviour and their learning. It is important to create a numeracy-rich learning environment with resources and activities that support quality teaching and learning of numeracy and encourage children to use appropriate numeracy concepts and skills in play and discussions with their peers and teachers.

**Teachers can consider the following questions as they plan to create a stimulating and conducive learning environment to support numeracy teaching and learning:**

- *What are the numeracy concepts and skills children should learn?*
- *How can the physical environment be set up?*
- *What are the activities to support children's learning?*
- *How can the children be organised to encourage active participation and interaction?*
- *What resources need to be provided?*
- *How can learning time be maximised to promote and support children's learning?*

## ORGANISING THE PHYSICAL ENVIRONMENT

The physical environment includes both the indoor and outdoor spaces of a preschool centre. It should be organised and set up to provide and promote meaningful and authentic learning experiences for children. It should arouse and sustain children's interest and curiosity in exploring and learning numeracy concepts independently or in groups. It should also allow opportunities for them to **revisit, reinforce and extend their learning** of numeracy concepts and skills. Activities planned should invite children to discuss and reflect on the processes/steps they take to explore and discover solutions in solving problems.

### Using Indoor Spaces to Support Numeracy Learning

The indoor spaces in a preschool centre include learning centres and common spaces for displays and activities. Resources and activities can be placed at learning centres to encourage active participation of children. Similarly, walls can be used for displays to promote and reinforce their learning, e.g., children's works that show how they used the different basic shapes to create a picture or another shape, interactive charts that encourage children to count or extend and create patterns, and a number line for children to revise and reinforce their understanding of number sequence and relationships between numbers.

## Construction/Block Play Centre



Children get to explore and discover spatial concepts, such as position and direction when they use blocks to build structures.

The Construction or Block Play Centre with building blocks or recycled materials can help children to develop knowledge of shapes and spatial awareness, such as position and direction. For example, children can explore and experiment using various construction materials to build houses of different shapes and sizes for the puppets at the Dramatic Play Centre. After building the houses, children can reflect on questions, such as “*Which of the houses built can fit the puppets? How do you know?*”, “*How can the puppets fit into the houses that you have built?*” and “*How many puppets can fit into one house?*”. In this way, they make discoveries, construct knowledge and develop logical thinking and the ability to reason by justifying and explaining their ideas.

## Table Toys/Manipulatives Centre

At the Table Toys or Manipulatives Centre, children get first-hand experience in moving and interacting with manipulatives (e.g., counters, unifix or multi-link cubes, beads, pattern blocks) and everyday objects (e.g., buttons, bottle caps, bread tags) to explore and revisit numeracy concepts and skills. For example, children learn to tell one shape from another by handling different pattern blocks or shape puzzles. They can match pattern blocks by shape or sort the blocks according to colour, shape or size.





Children can explore how to use the pattern blocks to form other shapes or figures at the Table Toys/ Manipulatives Centre.

### Dramatic Play Centre

Dramatic play encourages children to use numbers and compare things in contexts that are authentic and relevant to them. For example, a noodle stall can be set up for children to experience selling and buying bowls of noodles, discussing the number of fishballs they need to prepare and comparing and deciding on the length of noodles for their dishes.



The Dramatic Play Centre provides opportunities for children to use numeracy concepts and skills in contexts that are meaningful and relevant to them.

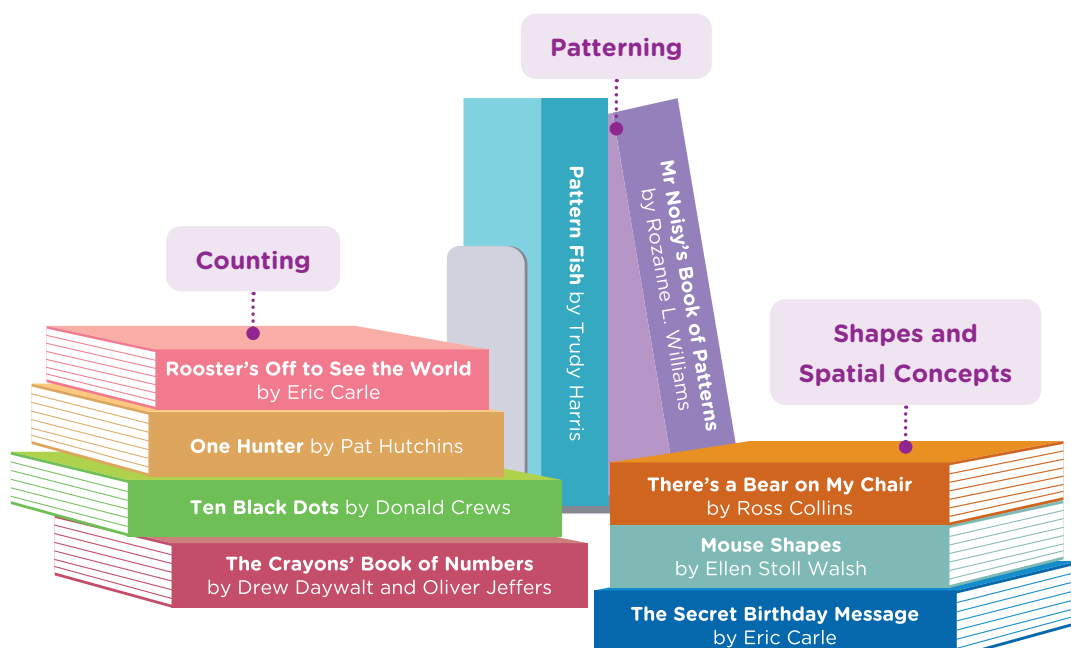


## Reading/Language and Literacy Centre



Provide books to help children explore numeracy concepts and practise skills at the Reading Centre.

Resources, such as picture books, songs, rhymes, puppet play and language games provide rich opportunities for children to explore and learn numeracy concepts and skills in different contexts. There is a range of stories and picture books that can be used for numeracy teaching and learning. Through interesting pictures and storylines, these books promote children's thinking and learning, as well as reinforce their understanding by engaging them in discussions about numeracy concepts and skills and using mathematical language and skills to answer questions from the story. Here are some examples of books to help children explore and learn numeracy concepts in a meaningful and enjoyable way:



Children can also demonstrate and practise numeracy skills through language games such as getting them to listen to short stories and mentally count the number of target words belonging to a category (e.g., colour, number, shape). Besides allowing children to practise numeracy skills, these games also help to enhance their executive functioning skills, such as the ability to focus and their working memory.

### Art and Craft Centre



Children can demonstrate their understanding of numeracy concepts such as creating shape patterns to decorate the border of their artwork.

The Art and Craft Centre provides opportunities for children to explore and learn numeracy concepts and skills in a different context, e.g., they can use different shape cut-outs to create a paper collage or patterns to decorate their artwork.

Teachers can also create opportunities that require children to practise counting skills and reinforce their spatial awareness in creating three-dimensional artworks, e.g., having children use six pipe cleaners, ten wooden craft sticks and seven square cardboard cut-outs to create a sculpture.

## Using Learning Centres to Cater to Diverse Learners

Activities at the learning centres can be planned and conducted to cater to children's different levels of understanding, especially after a new numeracy concept or skill has been introduced to the children. Teachers will need to observe and know what the children already know and what they find difficulty in to plan and carry out learning centre activities. The table below shows how follow-up activities can be planned for children to revisit, reinforce or extend their learning and understanding of counting reliably up to 10 things at the learning centres.

Observation of children	Purpose of follow-up activity	Examples of learning centre activities for counting reliably up to 10 things
<p>Children <b>have difficulty</b> showing their understanding of the concept of one-to-one correspondence.</p>	<p>To <b>revisit</b> the teaching and learning of one-to-one correspondence</p>	<p>Place bags with different quantities of counters from 1 to 10 at the Table Toys/ Manipulatives Centre. Invite each child to choose a bag of counters. Play a game by calling out a number between 1 and 10. Get the children to count the number of counters in their bag and raise their hands if they counted the quantity that matches the call out number.</p> <p>Observe the children as they count the number of counters they have. Take note of children who are not able to count in sequence accurately (e.g., unable to count up to 10, unable to keep track of the counters being counted, touching counters more than once) and provide them with further relevant support and scaffolding activities such as using fewer counters before progressing to larger quantities. To make the counting experiences more relevant and meaningful for the children, make use of other learning contexts and daily routines and transitions to provide concrete experiences for them to practise counting reliably, e.g., getting them to collect a certain quantity of play equipment for outdoor play, count to make sure that they have the correct number of children in their group for a game, count and distribute utensils to each child in the group during lunch.</p>

Children show **some understanding** of the concept of one-to-one correspondence.

To **reinforce** the teaching and learning of one-to-one correspondence

Prepare a tray of shape cut-outs for each group of four to five children at the Art and Craft Centre. Call out a number and shape and get each child in the groups to pick the correct number of shape cut-outs from their tray, e.g., pick five squares, three triangles, seven circles. Then get the children to use their shape cut-outs and work together in their groups to create a picture.

More activities can be provided to further reinforce the children's learning to ensure their fluency and accuracy in counting. Such activities include counting the number of squares they need to move to match the number of dots on a die during a board game and matching picture cards of different quantities of things with the correct numeral cards or number word cards during a matching card game.

Children **have understood** the concept of one-to-one correspondence.

To **extend** the teaching and learning of one-to-one correspondence

Prepare dot cards for 1 to 10 in random arrangements for each number and the corresponding numeral and number word cards for a pair of children to play a number game. Get the children to arrange the numeral/number word cards in order from 1 to 10. Ask one child to close his/her eyes and the other to remove one of the cards arranged. Once the card is removed, allow the first child to open his/her eyes and look for the dot card with the right quantity to match the missing numeral/number word card. Have the other check the answer before switching role with his/her partner. This number game helps to reinforce children's knowledge of counting reliably and number sequence.

More opportunities can be provided to extend the children's learning and understanding of number sequence. For example, having each child to pick a numeral/number word card and describe the number for the friend to guess e.g., *"This number is before 6 and after 4."*



## Using Outdoor Spaces to Support Numeracy Learning



Play a “Shape Hunt” game to encourage children to observe and identify shapes in the outdoors.

Children enjoy being outdoors, exploring the environment and discovering new and interesting things around them. The outdoors can therefore provide a stimulus for numeracy teaching and learning. Teachers play an important role in identifying learning opportunities in the outdoors and raising children’s awareness of various numeracy concepts around them. For example, get children to:

- Identify AB patterns in the outdoors, such as on the zebra crossing and the design on buildings
- Compare and discuss the size of the leaves of a plant
- Identify shapes in the environment such as play structures at the playground and discuss whether alternative shapes can be used to create that structure
- Discuss the number of play equipment to use and the pattern for arranging them to create an obstacle course and how to raise the level of difficulty
- Measure and compare the amount of sand/water that different containers can hold



Encourage children to observe and compare the length or size of the leaves they have picked in the park to develop or deepen their conceptual understanding of relationships between objects.

It is important for teachers to make use of both the indoor and outdoor spaces to support the teaching and learning of numeracy concepts and skills. Teachers should consider and reflect on children's indoor learning experiences and think of ways to enrich and extend children's learning through outdoor experiences. For example, plan both indoor and outdoor activities to support and enhance teaching and learning of patterning by getting children to recognise, extend and create patterns using counters in the classroom, identify similar patterns in the neighbourhood/garden and create patterns using twigs, pebbles, leaves or body movements, such as hop, hop, jump, hop, hop, jump during outdoor play.

## Selecting Resources to Support Numeracy Learning

Resources play an important role in supporting children's learning as they provide children with concrete experiences they need for numeracy development. Resources used in teacher-directed activities serve to introduce and illustrate the concepts and skills being taught. Resources used in self-directed activities provide opportunities for children to explore numeracy concepts and practise skills to help develop and deepen their understanding.

Careful selection and provision of resources are essential to support effective numeracy teaching and learning. Resources provided should be safe, durable and versatile enough to encourage children's exploration and self-discovery. They should be changed frequently to meet the learning objectives and keep children interested.



The tables below show some examples of resources that can be used to support teaching and learning of various numeracy concepts and skills.

### Resources for teaching and learning matching, sorting, comparing, ordering, patterning and counting

#### Counters



Counters are sets of small objects that can be used to support children's understanding of the various numeracy concepts. These include commercially bought counters (e.g., bear family counters, animal counters, fruit counters, coloured round counters), natural materials, (e.g., seeds, leaves, pebbles seashells) and commonly found objects (e.g., buttons, bottle caps, bread tags).

Teachers can use these counters to introduce a concept and design hands-on learning activities for children to establish their understanding of the concept as they move the counters around (e.g., sorting the bear family counters by colour to put them in their respective homes, counting the animal counters to determine the quantity so that they can decide how big they should build the enclosure for each type of animal).

Teachers can also use these counters to create a number or counting game to support children's numeracy learning.

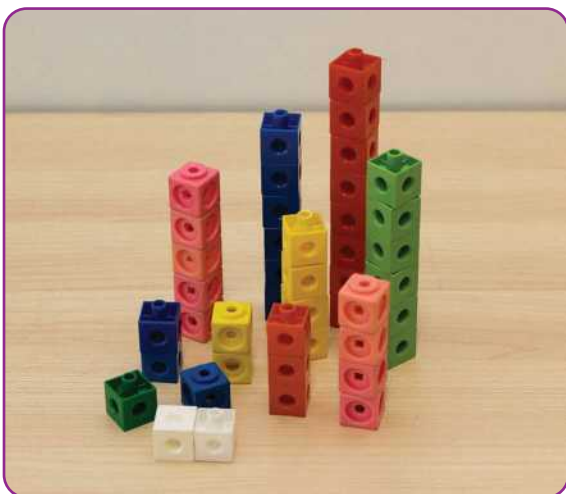


## Counting Boards



Counting boards provide meaningful contexts for children to practise their counting skills. For example, the children can pretend to be truck drivers and then count and use unifix or multi-link cubes to load the trucks in the counting boards.

## Linking Cubes



Multi-link cubes



Unifix cubes

Multi-link or unifix cubes usually come in different colours. These cubes can be used to facilitate children's learning of various numeracy concepts, such as matching, sorting, comparison of numbers and part-whole relationships.

For example, linking cubes of two different colours can be used to help children learn and understand part-whole relationship of a number. For example, give children some red and yellow cubes and ask them to create towers comprising five cubes. They can look at each other's cube towers and see how a tower of five cubes may be built differently, e.g., a child may use three yellow cubes and two red cubes while another may use four yellow cubes and one red cube.

### Beads and Laces



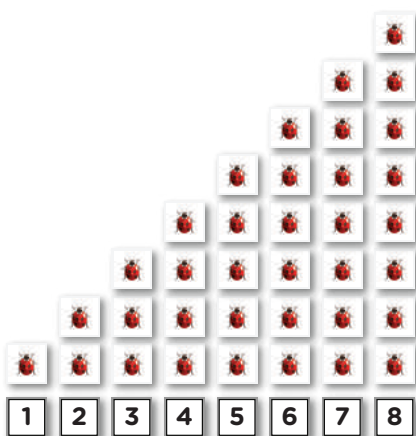
Stringing beads of different colours or shapes can be used to facilitate teaching and learning of patterning. For example, children can practise creating patterns by stringing two red round beads followed by two yellow square beads and then repeating the core unit of the pattern. At the same time, by stringing the beads, children can improve their eye-hand coordination and dexterity to strengthen their fine motor skills.

### Dice and Spinners



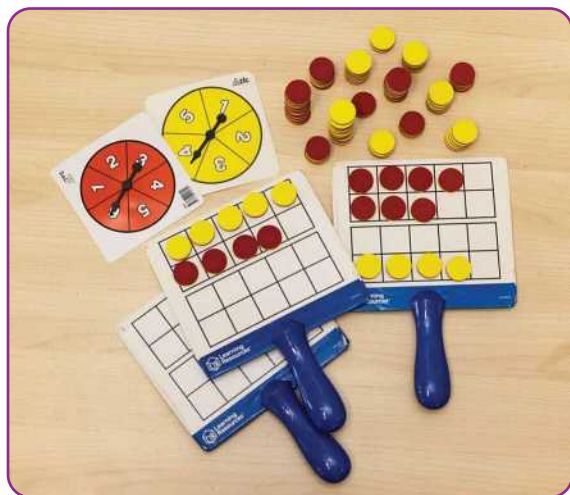
Dice and spinners can be used in board games or teacher-created activities. For example, roll a die or turn the spinner and get children to count and show counters corresponding to the number of dots on the face of the die or numeral on the spinner.

### Number Line



A number line can be used as a tool to reinforce counting skill and understanding of number sequence and the relationship between numbers. For example, children may be encouraged to use the number line to find the number which matches the number of toy cars or crayons they have. Children can also learn about ordering of numbers by filling in the missing numbers on the number line.

## Ten Frames

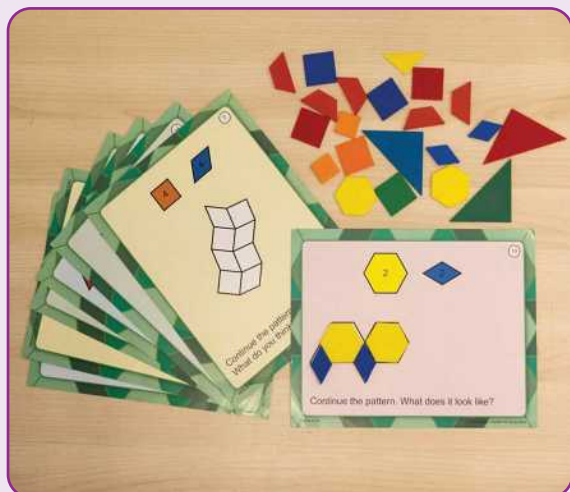


Ten frames comprise a row of boxes which are of the same size and each box is large enough to hold a counter. They can be commercially bought or self-created using materials such as egg cartons with ten sections.

The frames allow children to place a counter in each box to create a visual representation of quantities within the context of ten. Using a ten-frame and two-coloured counters, children can easily see that “6 is 1 more than 5”; “6 is less than 10”; and that “8 is 5 and 3 more” and “2 away from 10.”

## Resources for teaching and learning basic shapes and simple spatial concepts

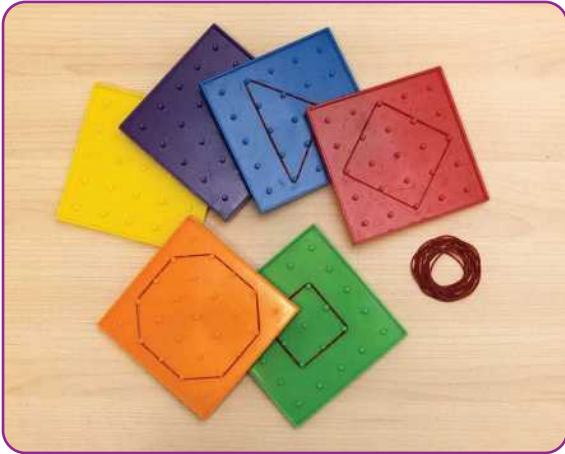
### Pattern Blocks



Pattern blocks can be made of wood or plastic. They usually come in six colours and six different shapes. Children can use these blocks to sort and group shapes based on different attributes, identify, extend and create shape patterns, as well as explore using shapes to create different figures.

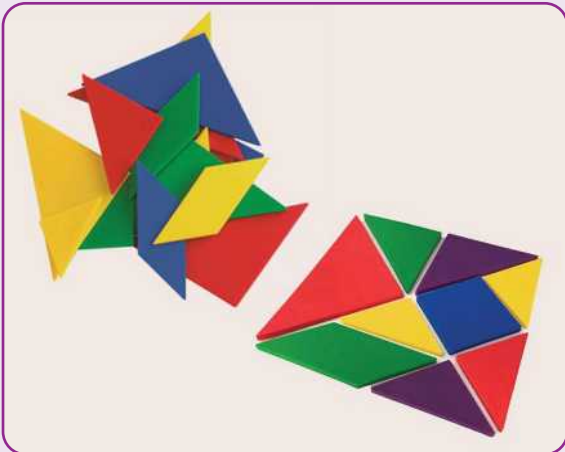


## Geoboards



Geoboards are plastic or wooden boards with a series of spaced pegs. Children can use rubber bands to form various shapes on the geoboards.

## Tangrams



Tangrams are sets of geometric shapes. Each set consists of two large triangles, one medium triangle, two small triangles, one square and one parallelogram. Children can explore using these geometric shapes to form different figures.

## Building Blocks



Building blocks are small wooden coloured blocks which are frequently used for table activities. Children can use these blocks to construct various structures and explore and discover the relationship between objects and their locations to strengthen spatial awareness.

## Other resources

### Board Games



Board games provide opportunities for children to explore fundamental number concepts, such as the counting sequence and one-to-one correspondence. These games, such as “Jumping on the Lily Pads” and “Snakes and Ladders” help children practise counting in sequence.

Simple finger games can also be used to facilitate teaching and learning of key numeracy concepts and skills, including counting, cardinality, subitizing and part-whole relationship.

### Information and Communication Technology (ICT) Tools



Digital cameras and communication devices, such as handphones, the internet and technology-enabled (Tech) toys are some examples of ICT tools that teachers can use to enhance the teaching and learning of numeracy concepts and skills. For example, children can use digital cameras to capture the patterns or shapes that they have identified in the environment, and these can be projected on a screen for class discussions.



## CREATING A POSITIVE INTERACTIONAL ENVIRONMENT

Teachers should create and maintain a caring and respectful learning environment. Such an environment encourages children to enjoy participating in various numeracy activities, be open to sharing their thoughts and ideas and to apply their learning. It also allows them to be open to explore various resources, suggest different solutions to problem-solve and make decisions based on their understanding of numeracy concepts. For example, Arif asks for six biscuits during snack time, which is two more biscuits than his usual quantity. He shares that he is asking to eat more biscuits as he feels hungry.



A caring and respectful environment in the preschool centre promotes positive interactions and encourages children to share their thoughts and ideas freely with one another and make choices confidently.

Teachers should observe and instead of intervening right away, provide the right scaffolding or empower children to come up with their solutions to a problem or resolve a situation in their daily experiences. This can be done through using prompts and questions such as, *“How can we make a bigger circle so that your friend can sit in the circle with us?”*.

Provide opportunities for children to exercise their autonomy and choice. This can be done by providing resources and activities that are open-ended where the children can incorporate their own ideas or ways to play and make decisions on how they would like to play or use the resources provided. This encourages them to be self-motivated and participate actively in their own learning.

## TAPPING THE TEMPORAL ENVIRONMENT

Children need sufficient time to explore and experiment with the resources provided and engage in activities to revisit, reinforce and/or extend the learning of the various numeracy concepts and skills. This would need to be done not only intentionally through numeracy-focused large or small group activities but through capitalising on daily classroom routines and transitions as well. As seen earlier, opportunities can be tapped throughout the day to reinforce the numeracy concepts/skills taught and make numeracy learning more authentic and meaningful for children. Further examples of such everyday activities include:

- Inviting children to think of ways to sort their water bottles to help them find their bottles easily when they need them. Get them to share their ideas with their friends.
- Engaging children in daily attendance taking by getting them to take turns to count the number of children present and absent and write the numbers on the board. This activity can be extended by getting children to compare the number of absentees between two days, for example, Monday and Friday and think of possible reasons for having more absentees on a particular day.
- While waiting for their turn to wash their hands, get children to sing number songs/ rhymes to reinforce their ability to count in sequence or play finger games to reinforce counting reliably and identifying numerals.

# Chapter 5

## MONITORING AND ASSESSING LEARNING AND DEVELOPMENT





Observe children while they are engaged in a counting activity to assess and monitor their progress in developing counting skills and number sense.

The knowledge and understanding of numeracy concepts vary from child to child as they learn and develop at their own pace. Children come with different prior knowledge, and they continually construct their knowledge of the various numeracy concepts based on their daily observations and interactions with the environment, adults and other children.

**Observing and understanding children's experiences is part of the teaching and learning process and teacher can make observations to:**

- Learn how children acquire pre-number concepts and understand the relationships between sets of things through the manipulation of concrete materials.
- Assess children's levels of understanding of numeracy concepts and skills, taking into consideration their prior knowledge (e.g., whether they are still grasping, have somewhat grasped or fully grasped the concept/skill).
- See how children apply their understanding of numbers and shapes in their daily experiences and how they think and try out different ways to solve a problem.

Observing children over time helps teachers to be aware of what children know and the difficulties they face. Being aware of children's levels of knowledge and understanding informs teaching practices to help children revisit, reinforce or extend learning. It also enables teachers to design learning activities with varying levels of difficulty to better meet the different learning needs of children.

## OBSERVING, DOCUMENTING AND ASSESSING CHILDREN'S LEARNING AND DEVELOPMENT

Teachers can be guided by a series of steps and questions as shown below when they observe, collect and reflect on information about children's learning and development across various learning contexts.

### WHAT?

- *What happens during the learning activity?*
- *What is the child doing?*
- *What is the child saying?*
- *To what extent is the child enjoying the activity?*

### SO WHAT?

- *What have I learnt about the child?*
- *What does the child already know?*
- *What has the child learnt?*
- *What are the difficulties faced by the child?*

### NOW WHAT?

- *How can I further support the child's learning?*
- *What materials can I provide at the learning centres to reinforce or extend the child's learning and development?*
- *How can I make the learning of the targeted concept/skill relevant and meaningful to the child's daily activities, including daily routines and transitions?*



For example, when teaching sorting, ordering and patterning, some questions that teachers can bear in mind to ascertain children's learning progress and understanding include:



- *Can they use attributes, such as colour, shape and size to sort objects?*
- *Can they briefly describe how they have sorted the objects?*
- *Can they suggest any other ways to sort the objects?*
- *Can they briefly explain why they have sorted the objects in another way?*



- *Can they identify and describe which object is longer or shorter than the other object?*
- *When they are comparing the length of the objects, do they make sure that they have placed their pencils/straws on a common line for comparing the length?*
- *Are they able to put the objects from shortest to the longest and describe the order?*



- *Can they identify patterns they see in the environment?*
- *Can they recognise, extend and briefly describe the patterns given?*
- *Do they extend patterns consistently (i.e., do not lose track of the core unit of the pattern as they make them longer)?*
- *Can they create and describe their own patterns?*

To assess children's understanding of numbers, teachers can find out if children can recognise numbers and match the numbers correctly to their respective quantities. For example, find out if a child is able to match the number name or numeral for number '3' to its quantity by showing three objects or pointing to the three dots on a dot card. If not, more learning experiences will need to be created (see activity ideas provided in Chapter 2 on developing counting skills, from simple to complex) for the child to revisit the learning of numbers to develop their counting skills and number sense.

Assessing children's learning is not about sitting children down to complete worksheets or tasks on numeracy concepts and skills. It can be done through games or children's daily activities throughout the day at the preschool centre. For example, teachers can assess children's ability to count by getting them to count the number of children in each group during outdoor play, the number of cherry tomatoes on their plate during lunch time, the number of blocks used to build the tallest structure at the Construction/Block Play Centre, and the number of animals found in a book.

When children are involved in counting activities, teachers should bear in mind the following questions to assess if they are ready for the next level of learning:



- *Do they use the correct counting sequence to count objects?*
- *Do they keep track of what they have counted and count each object only once?*
- *Are they able to count correctly regardless of the arrangement of the objects or the starting point of their count?*
- *Are they able to identify small sets of up to four or five objects instantly?*
- *Can they say a number name and give the correct number of objects corresponding to the quantity?*
- *Can they give a correct number of objects in response to a number name, numeral or number word?*



- *Can they compare two sets of objects and determine whether one set of objects is more than, fewer than or the same as the other set?*
- *Are they able to explain how they know that one set of objects is more than, fewer than or the same as the other set?*
- *Do they know the relationship between numbers? For example, 5 is more than 4 but less than 6?*
- *Can they name the parts that make up a number? For example, 5 is made up of 2 and 3 or 1 and 4.*



When children are exploring geometric shapes to understand the attributes that define shapes, teachers can bear in mind the following questions:



- *Are they able to identify the basic shapes?*
- *Are they able to describe the attributes that define each basic shape?*
- *Can they describe how one shape is different from another shape?*
- *Are they able to identify or draw shapes in different sizes or orientations?*
- *Can they use different shapes to form a figure?*
- *Can they form different figures with a given set of shapes?*



## EXAMPLES OF OBSERVATION, DOCUMENTATION AND ASSESSMENT OF CHILDREN'S LEARNING AND DEVELOPMENT

### Example 1

#### Context and Observation

The N2 children were learning about patterning. They went for a neighbourhood walk and identified the AB pattern on a zebra crossing and the arrangement of tiles used to decorate the walls in the neighbourhood. In the classroom, the children were encouraged to talk about the patterns they saw during their neighbourhood walk. They were then showed pictures of how coloured stones could be used to create patterns and invited to decorate the flowerpots of the potted plants in the garden using coloured stones. Each pair of children was given a bowl of coloured stones. The children sorted the coloured stones and selected two colours that they would like to use to create a pattern of their own on the flowerpots.

Arif took the lead and sorted the coloured stones onto two plates, one with red stones and the other with blue stones. He then created an AB pattern on his flowerpot. After he completed decorating his flowerpot, Arif began to explore using the remaining pebbles to create other patterns. When he saw that his partner, Pauline was struggling to create her pattern, he stopped his further pattern exploration and told her that her pattern was wrong. He showed her an example of a pattern using two colours. Arif then continued to explore and create a new pattern with the left-over pebbles. When asked what he had created, he explained that he had made a pattern of red stone, red stone, blue stone, blue stone, red stone, red stone, blue stone, blue stone, red stone, blue stone, red stone.

#### Documentation, Interpretation and Assessment

The teacher could document Arif's learning progress in the learning goals for Numeracy and other areas of learning and development as shown in the table below:

<b>Learning Goal/Other Indicators of Learning and Development</b>	<b>Documentation</b> <i>(What aspects of my observation of the child should I pay more attention on?)</i>	<b>Interpretation and Assessment</b> <i>(What do the observations tell me about the child?)</i>
<p>Learning Goal 2: Understand relationships and patterns</p> <p>Social and Emotional Competency 2: Develop self-management and regulation</p>	<ul style="list-style-type: none"> <li>During the pair activity on patterning, Arif took the lead to sort the coloured stones. He then very quickly created his AB pattern to decorate his flowerpot.</li> </ul>	<ul style="list-style-type: none"> <li>Arif showed that he was able to sort objects by colour and create the AB pattern.</li> </ul>

Social and Emotional Competency 3: Develop social awareness and show respect for diversity

Social and Emotional Competency 4: Build relationships with family, friends and significant adults

Values: care and respect

Executive Functioning Skills: working memory and inhibitory control

- When he saw that his partner had not created the right pattern, he told her that it was wrong and showed her an example of AB pattern.
- Then he explored and experimented with creating a more complex repeating pattern such as the AABB pattern while waiting for his friend to finish creating her AB pattern. But he did not complete creating the more complex pattern as he lost track of the pattern after completing two sets of the repeating unit.
- He has begun to experiment creating more complex repeating pattern such as AABBAABBAABB but was not able to remember and keep track of the core repeating unit. He needs more exposure and opportunities to explore and experiment with creating more complex patterns.
- Arif showed care and respect for his partner and helped her by demonstrating how to create the AB pattern. He also recognised that his peers may have different abilities from him. These abilities will help him build positive relationships with others.
- He also demonstrated self-control which is an important part of executive function as he did not rush to show his decorated flowerpot to his teacher nor continue to explore creating new patterns with the left-over pebbles. Instead, he stopped to help his partner create an AB pattern. This shows that he is able to regulate his emotions and actions.

Besides the anecdotal records shown above, samples of Arif's work (e.g., photographs of the patterns he had created) could also be used to support the teacher's interpretation and assessment of his learning and development. Information gathered should be used to guide the planning of subsequent activities to reinforce and extend Arif's numeracy learning and other aspects of his development.

### **Possible Follow-up Activities to Reinforce/Extend Learning**

- Show Arif more examples of complex repeating patterns and ask him to copy and extend the pattern which will allow him to extend his learning about patterning. This can also help to improve his working memory skills as he must first identify the pattern and then hold that pattern in his mind for a while in order for him to extend the pattern.
- Provide other opportunities for him to create more complex patterns using different resources such as decorating a photo frame using craft materials and invite him to share how he has created these patterns. Such opportunities will further allow Arif to develop his understanding of patterning and help to improve his executive functioning skills by practising his planning and organisation skills as he learns to choose the materials he would like to use and then decide what pattern he would like to create.

## Example 2

### Context and Observation

The K1 children were playing at the learning centres. Brena and her friends were role-playing at the Dramatic Play Centre. Brena pretended to be a baker selling cakes, bread and biscuits to her friends. The children created shopping lists of bread, biscuits and cakes to buy from Brena. Brena sold cakes, bread and biscuits to her friends according to their shopping lists by counting and taking each food item from a tray before putting them into a bag. She sold the correct number of bread, cakes and biscuits on their shopping lists when these had five or fewer items. But she did not consistently sell the correct number of bread, cakes and biscuits on the shopping lists with more than five items as she counted some of the items twice or three times. She walked away when her friends told her that she had counted the items wrongly.

### Documentation, Interpretation and Assessment

The teacher could document Brena's learning progress in the learning goals for Numeracy and other areas of learning and development as shown in the table below:

<b>Learning Goal/Other Indicators of Learning and Development</b>	<b>Documentation</b> <i>(What aspects of my observation of the child should I pay more attention on?)</i>	<b>Interpretation and Assessment</b> <i>(What do the observations tell me about the child?)</i>
<p>Learning Goal 3: Develop counting skills and number sense</p> <p>Social and Emotional Competency 2: Develop self-management and regulation</p> <p>Executive Functioning Skills: inhibitory control and working memory</p>	<ul style="list-style-type: none"> <li>Brena could accurately pack quantities of up to five objects but showed some inconsistencies in packing objects beyond five.</li> <li>She was accurate in packing six objects two out of four times.</li> <li>When she counted and placed each item onto a tray one at a time before putting them into the bag, she could get the correct number of bread, biscuits or cakes.</li> </ul>	<ul style="list-style-type: none"> <li>Brena was able to count reliably up to five objects.</li> <li>She had difficulty in counting reliably using one-to-one correspondence beyond five things as she was unable to remember to keep track of the last number counted or count in sequence after 5.</li> </ul>

- But she would sometimes count incorrectly when she tried to count the items while putting them directly into the bag as she either could not keep track of the last number counted or counted a few items two to three times.
- She did not listen to her friends when they told her she had counted the items wrongly and stopped to play by walking away.
- Brena needs to learn to express and manage her emotions and behaviour appropriately when she was told that she did not count correctly.

In addition to the anecdotal records shown above, examples of Brena's learning experiences (e.g., photographs showing her counting experience at the learning centre) could also be used to support the teacher's interpretation and assessment of Brena's learning and development. The teacher should make use of this information to guide the planning of subsequent activities to allow Brena to further develop her understanding of counting reliably and in sequence beyond five, as well as to help her express her feelings and emotions, such as anger and frustration, appropriately and to control impulsive behaviours.

### Possible Follow-up Activities to Reinforce/Extend Learning

- Encourage Brena to sing number songs/rhymes to practise saying the number names in order.
- Help her keep track of the starting point of counting by teaching her to put the objects in rows before counting them.
- Provide more opportunities for her to practise counting concrete objects using one-to-one correspondence appropriately without moving each counted object away so that she can use her working memory to keep track of the counted and uncounted objects in the collection of objects.
- Use objects in pictorial form to help Brena count reliably without touching the objects. Give her picture cards of objects in various quantities from 1 to 10 in different arrangements and play a counting game to determine the number of objects on each card shown.
- Teach her strategies (e.g., take a deep breath and count to 5) to calm herself when she is feeling unhappy, angry or upset about something.
- Plan activities to improve her working memory, e.g., playing matching card games, singing songs with actions, moving to specified rhythms using body percussion.



## Example 3

### Context and Observation

The K2 children were asked to complete a family-based activity to find out how many cups of water they drink in a day. Each child was given an activity sheet and a 250 ml disposable cup to take home. Parents were encouraged to complete the activity with their child over the weekend. The children recorded the number of cups of water drunk on Saturday and Sunday by drawing and writing the number of cups of water on the activity sheet.

In the classroom, the children were asked to work in pairs to compare who drank more water on Saturday and Sunday. Jian En suggested to Sherman that he would compare the number of cups for Saturday and Sherman would compare for Sunday. After comparing their water consumption, Jian En said, *"I drank five cups of water and Sherman drank two cups of water on Saturday."* He went on to say that he drank more water than Sherman. But when Sherman said, *"I drank four cups of water and Jian En drank five cups of water on Sunday."* Jian En seemed to be unsure whether he had drunk more water than Sherman on Sunday. He told Sherman that he drank more than him. But Sherman told him that he was wrong, and Jian En looked puzzled, but he accepted Sherman's answer.

When children were engaged in a discussion to learn about the importance of drinking enough water in a day (i.e., three to five cups of water) and checking whether they had drunk enough water, Jian En would call out the answers immediately when the difference in the number of cups was large. However, when the difference was small, he would wait for his friends to answer.

### Documentation, Interpretation and Assessment

The teacher could document Jian En's learning progress in the learning goals for Numeracy and other areas of learning and development as shown in the table below:

<b>Learning Goal/Other Indicators of Learning and Development</b>	<b>Documentation</b> <i>(What aspects of my observation of the child should I pay more attention on?)</i>	<b>Interpretation and Assessment</b> <i>(What do the observations tell me about the child?)</i>
Learning Goal 3: Develop counting skills and number sense	<ul style="list-style-type: none"> <li>Jian En worked with his partner to compare the number of cups of water they had drunk on Saturday and Sunday.</li> </ul>	<ul style="list-style-type: none"> <li>Jian En was able to work cooperatively with a partner on a common task.</li> </ul>

Social and Emotional Competency 1: Develop self-awareness

Social and Emotional Competency 4: Build relationships with family, friends and significant adults

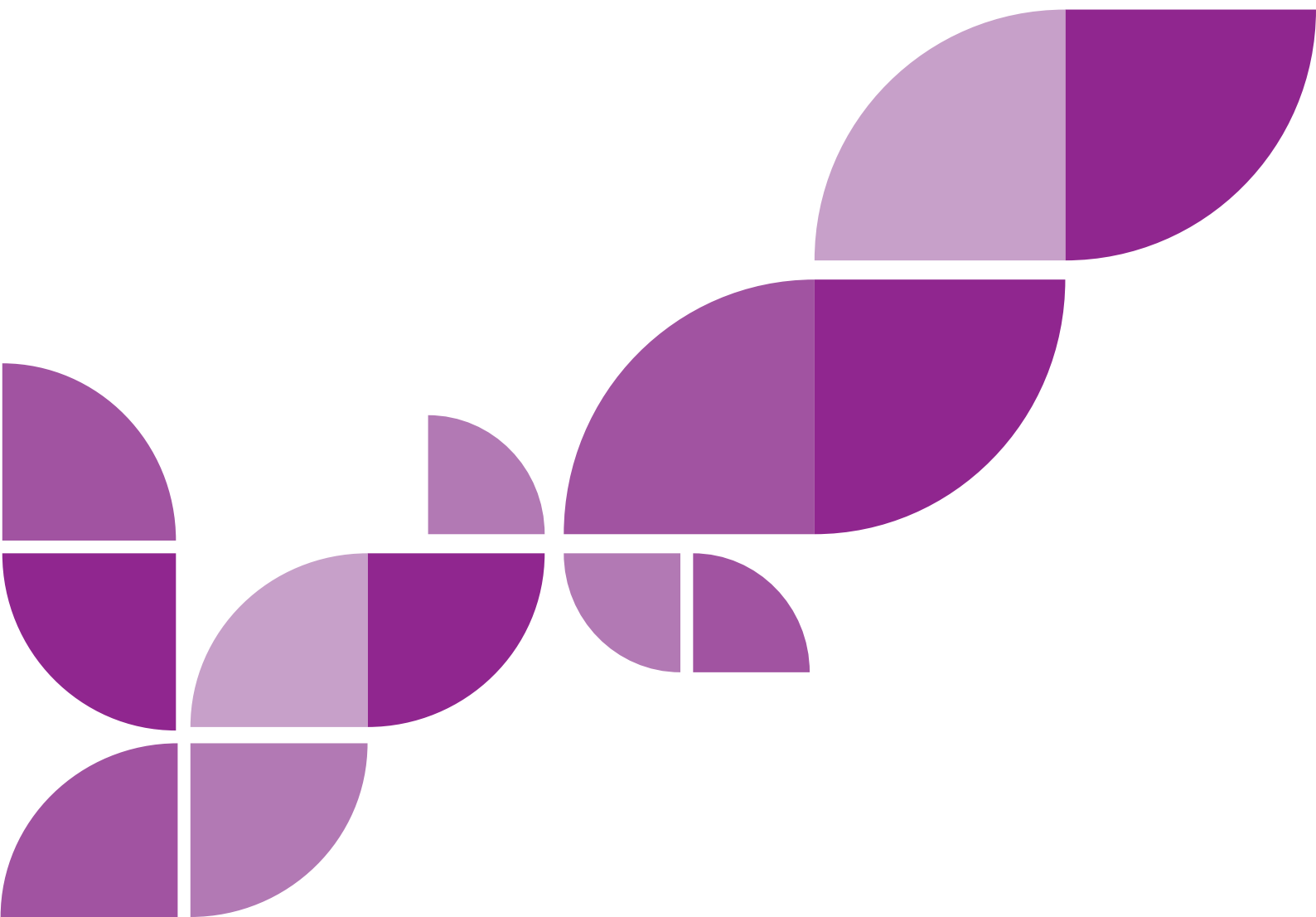
- He counted the cups of water he and his partner drank on Saturday accurately.
- He was able to say that he drank more water on Saturday as he had drunk five cups of water which were more than two cups of water drunk by his partner.
- When comparing the number of cups of water drunk on Sunday, he was not sure whether his five cups of water were more than four cups of water drunk by his partner.
- When he was not sure of the answer, he would either accept his friend's answers or keep quiet.
- He showed confidence in counting reliably to at least five things when given groups of objects.
- He was able to compare the quantities of two groups of objects and use language such as "more than" to verbally describe that one group was more than the other when the difference between the two groups was large, e.g., five and two cups of water.
- However, he was not able to make the comparison when the difference was small, e.g., five and four cups of water.
- When he was not sure of the answer, he did not seek clarifications from his friend and would either accept his friend's answers or keep quiet.

Besides the anecdotal records shown above, examples of Jian En's learning experiences (e.g., photographs of him working with his partner to compare and find out the number of cups of water they had drunk) could also be used to support the teacher's interpretation and assessment of his learning. Information gathered should be used to guide the planning of subsequent activities to reinforce and extend Jian En's learning.

### Possible Follow-up Activities to Reinforce/Extend Learning

- Give Jian En more opportunities to work with manipulatives such as linking cubes, where he could stack them using different number of cubes to compare the quantities, starting with a big difference between two quantities before progressing to comparing quantities with a smaller difference. This will help him build confidence in comparing the quantities of sets of things.
- Provide guidance to Jian En on how the arrangement of objects could help him compare two groups of objects and determine the difference. For example, arrange the cups or any other objects in two rows, pair up the cups by drawing a dotted line from the cup in the first row to the corresponding cup in the second row to get the difference in quantity.
- Encourage Jian En to ask questions when in doubt or to find out more about something and affirm him whenever he makes an attempt to seek clarification from his peers or teachers.

# Bibliography



- Aunio, P., & Rasanen, P. (2015). Core numerical skills for learning mathematics in children aged five to eight years – A working model for educators. *European Early Childhood Education Research Journal*, 24(5).
- Baroody, A. J. (2010). *Fostering early numeracy in preschool and kindergarten*. Encyclopedia on Early Childhood Development.
- Biemiller, A., & Boote, C. (2006). An effective method for building meaning vocabulary in primary grades. *Journal of Educational Psychology*, 98(1), 44-62.
- Björklund, C., & Ahlskog-Björkman, E. (2017). Approaches to teaching in thematic work: Early childhood teachers' integration of mathematics and art. *International Journal of Early Years Education*, 25(2), 98-11.
- Chang, S. H., Lee, N. H., & Koay, P. L. (2017). Teaching and learning with concrete-pictorial-abstract: A proposed model. *The Mathematics Educator*, 17(1), 1-28.
- Chard, D. J., Clarke, B., Baker, S., Otterstedt, J., Braun, D., & Katz, R. (2005). Using measures of number sense to screen for difficulties in mathematics: Preliminary findings. *Assessment Issues in Special Education*, 30(2), 3-14.
- Charlesworth, R. (2005). *Experiences in math for young children* (5th Ed.). New York: Thomson Delmar Learning.
- Charlesworth, R., & Lind, K. K. (2012). *Math and science for young children* (7th Ed.). New York: Thomson Delmar Learning.
- Clements, D. H. (1999). 'Concrete' manipulatives, concrete ideas. *Contemporary Issues in Early Childhood*. 1(1), 45-60.
- Clements, D. H. (1999). Subitizing: What is it? why teach it?. *Teaching Children Mathematics*, 5(7), 400-405.
- Clements, D. H. & Sarama, J. (2009). *Learning and teaching early math: The learning trajectories approach*. New York: Routledge.
- Clements, D. H., Samara, J., & Germeroth, C. (2016). Learning executive function and early mathematics: Directions of causal relations. *Early Childhood Research Quarterly*, 36, 79-90.
- Clerkin, A., & Gilligan-Lee K. (2018). Pre-school numeracy play as a predictor of children's attitudes towards mathematics at age 10. *Journal of Early Childhood Research*, 16(3), 319-334.



- Copley, J. V. (2000). *The young child and mathematics*. Washington, D.C.: National Association for the Education of Young Children.
- Cragg, L., & Gilmore, C. (2014). Skills underlying mathematics: The role of executive function in the development of mathematics proficiency. *Trends in Neuroscience and Education*, 3(2), 63-68.
- Cragg, L., Keeble, S., Richardson, S., Roome, H. E., & Gilmore, C. (2017). Direct and indirect influences of executive functions on mathematics achievement. *Cognition*, 162, 12-26.
- Diller, D. (2011). *Math work stations: Independent learning you can count on, K-2*. Portland, Maine: Stenhouse Publishers.
- Education Endowment Foundation. (2020). *Improving mathematics in early years and key stage 1 – guidance report*. UK, London: Education Endowment Foundation.
- Furner, J. M. (2018). Using children's literature to teach mathematics: An effective vehicle in a STEM world. *European Journal of STEM Education*, 3(3), 14.
- Forsten, C., & Richards, T. (2009). *Math talk: Teaching concepts and skills through illustrations and stories*. Peterborough, New Hampshire: Crystal Springs Books.
- Geary, D. C., Hamson, C. O., & Hoard, M. K. (2000). Numerical and arithmetical cognition: A longitudinal study of process and concept deficits in children with learning disability. *Journal of Experimental Child Psychology*, 77(3), 236-263.
- Gifford, S. (2005). *Teaching mathematics 3-5: Developing learning in the foundation stage*. Berkshire: Open University Press.
- Horst, J. S., Parsons, K. L., & Bryan, N. M. (2011). Get the story straight: Contextual repetition promotes word learning from storybooks. *Frontiers in Psychology, Volume 2*, Article 17.
- Hynes-Berry, M., & Grandau, L. (2019). *Where's the math? Books, games, and routines to spark children's thinking*. Washington, D.C.: National Association for the Education of Young Children.
- Jordan, N. C., Kaplan, D., Ramineni, C., & Locuniak, M. N. (2009). Early math matters: Kindergarten number competence and later mathematics outcomes. *Developmental Psychology*, 45(3), 850-867.
- Leong, Y. H., Ho, W. K., & Cheng, L. P. (2015). Concrete-Pictorial-Abstract: Surveying its origins and charting its future. *The Mathematics Educator*, 16(1), 1-18.

- Luedtke, M., & Survan, K. (2017). Using children's literature to enhance math instruction in - K-8 classrooms. In L. Jao & N. Radaovic (Eds.), *Transdisciplinarity in mathematics education: Blurring disciplinary boundaries* (pp. 47-71). Berlin: Springer.
- Montague-Smith, A., & Price, A.J. (2012). *Mathematics in early years education*. New York: Routledge.
- Polya, G. (1973). *How to solve it*. Princeton, NJ: Princeton University Press.
- Pound, L. (2006). *Supporting mathematical development in the early years* (2nd Ed.). Berkshire: Open University Press.
- Reid, K. (2016). Changing minds: Discussions in neuroscience, psychology and education. *Australian Council for Educational Research*.
- Reid, K., & Andrews, N. (2016). Fostering understanding of early numeracy development. *Australian Council for Educational Research*.
- Ribner, A. D. (2020). Executive function facilitates learning from math instruction in kindergarten: Evidence from ECLS-K. *Learning and Instruction*, 65, 101-251.
- Sarancho, O. N., & Spodek, B. (2009). Educating the young mathematician: The twentieth century and beyond. *Early Childhood Education Journal*, 36(4), 305-312.
- Smith, S. S. (2012). *Early childhood mathematics* (5th Ed.). Boston: Pearson Education, Inc.
- Van de Sluis, S., De Jong, P. F., & Van der Leij, A. (2007). Executive functioning in children, and its relations with reasoning, reading, and arithmetic. *Intelligence*, 35(5), 427-449.
- Verdine, B. N., et al. (2014). Contributions of executive function and spatial skills to preschool mathematics achievement. *Journal of Experimental Child Psychology*, 126, 37-51.
- Verdine, B. N., et al. (2014). Finding the missing piece: Blocks, puzzles and shapes fuel school readiness. *Trends in Neuroscience and Education*, 3(1), 7-13.
- Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). *Executive function: Implications for education*. National Center for Education Research.



Ministry of Education  
SINGAPORE

Pre-school Education Branch

ISBN 978-981-18-7429-1



9 789811 874291