Nurturing Early Learners
A Curriculum for Kindergartens in Singapore

NUMERACY
Acknowledgements

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Kindergartens
Ar-Raudhah Mosque Kindergarten
Bethesda (Katong) Kindergarten
Jurong Calvary Kindergarten
PCF Bishan East (Block 144)
PCF Cheng San-Seletar (Block 435)
PCF Hong Kah North (Block 315-319)
PCF Kaki Bukit (Block 519-545)
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PCF Pioneer (Block 654B)
PCF Tampines East (Block 261)
Seventh-day Adventist Kindergarten
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Introduction

Development of numeracy concepts and skills involves helping children know and use the concepts and skills in ways that relationships and connections are formed and then apply them meaningfully in their daily experiences.

When children first come to a pre-school centre, they bring with them knowledge and experiences about numbers, shapes and space in the environment. They see numeracy concepts and skills being used at home and in the community. For children to make sense of their daily encounters with numeracy, teachers should build on this prior knowledge by designing learning activities that enable them to make connections between what they already know and can do, and what we have planned for them to learn in relevant and realistic contexts.

Children should be provided with many hands-on learning experiences so that they can construct their own understanding. When children have opportunities to manipulate concrete materials, they will notice relationships in numeracy, how they connect to one another and with other learning areas. Children should also be provided 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. Teachers should take time to observe what children do, listen to what they say and facilitate the understanding of numeracy concepts.
Chapter 1

Numeracy in the Early Years

Children’s thinking in the early years is naturally dominated by their perception or what their senses tell them. To help them in the learning and development of various abstract numeracy concepts, it is important to provide them with opportunities to:

- Explore with objects
- Hear the sounds of the words representing the objects
- Look at pictures of the objects
- Recognise written words or symbols in their daily play experiences
- Talk about their solutions when solving problems

These opportunities will help them in the development of skills and concepts such as matching, sorting, comparing, ordering, patterning, counting and number sense, basic shapes and space.
Simple Relationships and Patterns

Knowing simple 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 means seeing a relationship, or noticing that things have something in common. For example, a child puts 2 toy cars together as they are the same and puts 2 red flowers in the vase as they have the same colour. A child can also match objects based on shape, size, texture and function (e.g. fork and spoon). Understanding the concept of sameness will help children to match a picture card of 5 rabbits to a picture card of 5 carrots as both have the same quantity of 5.

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, which are different and then put them in the respective groups. Putting objects in groups and dealing with the relationships within a group and among different groups help develop logical thinking and reasoning. It also helps children to understand that if they need to know the total number of cars from a set of vehicles, they only count all the cars and not the vans and buses.
Comparing

Comparing means looking at 2 objects or 2 sets of objects and finding how they are similar and different. When children compare, they will notice a relationship between the 2 objects in terms of attributes such as size (e.g. This car is big and the other car is small or this car is bigger than the other car) and length (e.g. the rope is longer than the string). If children are comparing quantities (i.e. more than and less/fewer than), they look at 2 sets of objects and decide which set has more or which set has less.

Ordering

Ordering involves comparing more than 2 objects or 2 sets of objects and putting them in a certain order such as by size (e.g. smallest to biggest or biggest to smallest) or length (shortest to longest, longest to shortest). It is more difficult than comparing because now children must make several decisions. For example, with 3 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. Ordering also involves placing things in a sequence where order has a meaning. For example, the sequence of events in a story provides structure for the plot. 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 (e.g. small to large quantity, large to small quantity).

Patterning

Patterning is a form of ordering. Children usually begin to do patterning that contains an element of repetition. AB pattern is an example of a repeating pattern where the core is AB and this pattern must end with B such as yellow car (A), red car (B), yellow car (A), red car (B), yellow car (A), red car (B).

Children should be provided with opportunities to identify patterns in their environment (e.g. stripes on a zebra, patterns on fabric and wrapping papers) before getting them to extend and create patterns. They can learn to identify patterns using various manipulatives such as stringing beads or putting pegs on a pegboard in specific patterns such as red, blue, red, blue, red, blue. Children can also use sounds and movements to create patterns.

Once children are able to recognise the underlying order and predictability in the patterns they experience, they will begin to create their own patterns. More repeating patterns, such as ABC, AAB and AABB patterns, and growing patterns, such as AB ABB AABB, could be introduced to raise their awareness of a variety of patterns.
Counting and Number Sense

Acquiring counting skills and developing number sense help children understand the concept of numbers and their relationships. Children should be provided with learning experiences where they need to count, compare, combine and take apart numbers. In order for the concept of numbers to be meaningful to the children, these learning experiences must be authentic and relevant to the children during play or as they occur in the real world.

Rote Counting

Rote counting is reciting the sequence of number names – 1, 2, 3, and so on. It is a memory task, like reciting the letters of the alphabet. Children who have not learnt this verbal sequence will not be able to count. But learning the sequence of number names or rote counting does not ensure that children actually can count with accuracy and understanding.

Rational Counting

Beyond knowing the numbers in sequence, counting requires linking a single number name with one and only one object at a time; that is, **one-to-one correspondence**.
Children need to coordinate the touch and verbal counting of numbers so that these happen at the same time. Children sometimes touch more than one object when they say one number, or conversely they say several numbers and touch only one object. In other words, children’s verbal or rote counting often seems to have no relation to the objects they are trying to count. One-to-one correspondence for the counting sequence is a skill that must be taught. A basic understanding of accurate rote counting and one-to-one correspondence is the foundation of rational counting.

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 the count does not just label the last item counted but also represents the number of objects in the set.
Number Sense

Number sense is beyond knowing number names or counting. It focuses on the understanding of the relationship between numbers and quantities. It includes ‘more’ and ‘less’, conservation of quantity and part-whole relationship.

Early experiences should focus on determining whether one set of objects is more than, less than or the same as the other set of objects. For example, when children see a plate of 5 apples and a plate of 2 apples, they are able to determine that the plate of 5 apples is more than the plate of 2 apples. Once the children are able to determine that one set of objects is more/less than or the same as the other set of objects, the learning activities provided could focus on getting children to determine how many more or how many less objects there are.

Conservation of quantity is the understanding that spreading out or putting closely a group of objects does not affect its quantity. When children are able to conserve quantity, they know that 2 sets of 5 objects have the same quantity even if the objects of one set are arranged further apart from each other.

Part-whole relationship is an understanding that a number can be composed of smaller parts. Children should understand that 5 can be made up of 2 apples and 3 apples or 1 apple and 4 apples. When children are able to interpret a quantity in terms of its parts, it lays the foundation for understanding operations such as addition and subtraction.

Subitizing is an important skill that relates to the development of children’s number sense. It refers to the ability to recognise the number of objects in a set without actually counting each individual object. Children who can identify small quantities in different arrangements, such as those on dominoes or dice, without actually counting them one by one, have a strong sense of quantity.
Basic Shapes and Simple Spatial Concepts

Identifying and naming basic 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/things around them and using the language of position (e.g. top, bottom, in front of, behind) and movement (e.g. up, down, left, right) to describe it. Exploration of basic shapes and understanding of simple spatial concepts lay the foundation for geometry in future learning.

Children use rubber bands to explore the different shapes that they can create on the geoboard.
Basic Shapes

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. When they manipulate shapes, they begin to explore how they can fit different shapes together to form new figures.

Simple Spatial Concept

Spatial awareness helps children understand the relationship between objects and their locations, and their body and other objects. Constructing buildings with blocks and 3-dimensional materials and manipulating with shapes such as tangrams and pattern blocks are different experiences which allow children to represent the locations of objects in space. Positional words (e.g. top, bottom, in front of, behind) can be used as children play in the Block Centre or in the Dramatic Play Centre. When children stack objects, they can talk about the one on top and the one at the bottom. Directional words (e.g. up, down, left, right) involve movement. Children can use them as they perform actions in games and movement activities or play with toys that have the capacity to move, such as cars and trucks.
Summary

The focus of development of numeracy concepts and skills should be on providing opportunities for children to know, use and apply numeracy concepts and skills meaningfully in their daily experiences. The provision of numeracy experiences should build on children’s prior knowledge with an emphasis on learning from the manipulation of concrete materials. Through the use of manipulatives, pictures and symbols, children will notice the relationships between sets of things to be matched, sorted, compared, ordered, made into patterns and counted. They will also develop their understanding of basic shapes and simple spatial concepts.
Chapter 2

Learning Goals for Numeracy

In the pre-school years, it is important to focus on developing essential pre-number, early number, shape and simple spatial concepts to lay a strong foundation for mathematics learning.

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

- Match things that are the same and sort things that are different from the rest
- Pair things that go together, put things in order and create simple repeating patterns
- Count numbers in order, recognise numbers and know the quantity of sets of things
- Recognise and identify basic shapes and be aware of the spatial relationship between them and the people/things around them

The examples in this chapter illustrate how teachers can provide opportunities for children to acquire knowledge, skills and dispositions of the learning goals.
**Learning Goal 1**

**Learning Goal 1:** Recognise and use simple relationships and patterns

<table>
<thead>
<tr>
<th>Key knowledge/skills/dispositions</th>
<th>Examples of what children’s learning and development look like...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Match, sort and compare things by one attribute (i.e. according to colour, shape or size)</td>
<td>Find and put similar objects together</td>
</tr>
<tr>
<td>Put things in an order according to size or length and sequence events</td>
<td>Identify 2 pattern blocks that have the same colour, shape or size</td>
</tr>
<tr>
<td>Recognise, extend and create simple patterns (i.e. AB pattern)</td>
<td>Pair things such as a cup to a saucer, a fork to a spoon</td>
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<td></td>
<td>Pair sets of things that are the same such as 3 girls and 3 baskets</td>
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<tr>
<td></td>
<td>Sort objects into 2 groups</td>
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<tr>
<td></td>
<td>Spot differences, such as colour, shape or size between objects</td>
</tr>
<tr>
<td></td>
<td>Put objects in groups according to colour, shape or size</td>
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<tr>
<td></td>
<td>Compare 2 objects by length and use appropriate comparative vocabulary (e.g. longer than/shorter than)</td>
</tr>
<tr>
<td></td>
<td>Show and use ‘same’ and ‘different’ when comparing things</td>
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<tr>
<td></td>
<td>Make and read from real object graph (e.g. form two rows of children and compare which row has more children)</td>
</tr>
<tr>
<td></td>
<td>Put things in an order such as from small to big, from short to long, or 1st, 2nd, 3rd</td>
</tr>
<tr>
<td></td>
<td>Indicate order in a sequence of events using ‘first’, ‘second’, ‘third’, ‘next’ and ‘last’</td>
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<tr>
<td></td>
<td>Identify, compare and sequence events in their daily routine such as breakfast (morning), lunch (noon), snack (afternoon), dinner (evening), sleep (night)</td>
</tr>
<tr>
<td></td>
<td>Name and order the days of the week and months of the year</td>
</tr>
<tr>
<td></td>
<td>Recognise repeated patterns in things they see around them such as fabric, wrappers, flower petals and animals like zebras and tigers</td>
</tr>
</tbody>
</table>
Children learn to match as they play a game to look for and match picture cards that have the same objects.

- Reproduce a given repeated pattern using objects (e.g. pencil, eraser, pencil, eraser, pencil, eraser) or pattern blocks (e.g. square, circle, square, circle, square, circle)

- Create repeated patterns using objects, words, drawings, symbols or actions.

Note: The examples of children’s learning and development are neither age-specific nor exhaustive. Teachers have the flexibility to provide appropriate learning opportunities based on their children’s abilities, interests and developmental needs.
### Examples of Activities

The table below shows examples of activities that can be planned for learning goal 1.

<table>
<thead>
<tr>
<th>Key knowledge/skills/dispositions</th>
<th>Learning objectives</th>
<th>Activities</th>
</tr>
</thead>
</table>
| Match things by one attribute (i.e. according to color, shape or size) | Match identical things | • Look for things that are the same in the classroom or during a neighbourhood walk.  
• Play a card game to match picture cards that have the same objects. |
|                                  | Match things by colour | • Play a matching game using unifix cubes to select and match cubes with the same colour.  
• Play a lotto game to match by colour. |
|                                  | Match things by shape | • Feel and find 2 blocks that have the same shape from a bag of pattern blocks.  
• Search and match cut-outs by shape. |
|                                  | Match things by size | • Look for 2 buttons that are the same size from a collection of buttons.  
• Play card games such as “Snap” to match picture cards which show objects of the same size. |
| Sort things by one attribute (i.e. according to color, shape or size) | Sort two groups of objects | • Sort a collection of objects into 2 groups. |
|                                  | Sort things by colour | • Sort a bowl of assorted beans (e.g. red beans, green beans, soya beans, black beans) by colour. |
|                                  | Sort things by shape | • Make dough cookies in different shapes and sort them into different plates by shape. |
|                                  | Sort things by size | • Sort a basket of balls (e.g. ping pong balls, tennis balls and basket balls) by size.  
• Sort a variety of spoons by size. |
<p>| Compare things by one attribute (i.e. size or length) | Compare things by size | • Compare 2 similar objects such as a big ball and a small ball by using appropriate comparative vocabulary such as “bigger than” and “smaller than”. |
|                                  | Compare things by length | • Play a comparison game using straws of different lengths and a self-made die with words ‘short’ and ‘long’. Throw the die and if the die indicates ‘short’, each child chooses a straw from his/her bundle. Both children will compare the straws that they have picked. The child with the shorter straw wins. |</p>
<table>
<thead>
<tr>
<th>Key Knowledge/Skills/Dispositions</th>
<th>Learning Objectives</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Put things in an order according to size or length and sequence events</td>
<td>Put things in an order according to size (e.g. smallest to biggest, biggest to smallest)</td>
<td>• Compare and order different types of balls (e.g. a ping pong ball, a tennis ball, a basketball) by size.</td>
</tr>
<tr>
<td></td>
<td>Put things in an order according to length (e.g. shortest to longest, longest to shortest)</td>
<td>• Arrange a bundle of strings by length.</td>
</tr>
<tr>
<td></td>
<td>Put things in an order according to sequence of events</td>
<td>• Sequence the events in the story using picture cards.</td>
</tr>
<tr>
<td>Recognise, extend and create simple patterns (i.e. AB pattern)</td>
<td>Recognise AB patterns</td>
<td>• Go on a neighbourhood walk to observe and describe patterns in the environment such as tile patterns on walls and the floor and patterns on curbs.</td>
</tr>
<tr>
<td></td>
<td>Recognise and extend AB patterns</td>
<td>• Identify and extend AB patterns using counters.</td>
</tr>
<tr>
<td></td>
<td>Recognise, extend and create AB patterns</td>
<td>• Use beads to create necklaces with an AB pattern.</td>
</tr>
</tbody>
</table>
**Learning Goal 2**

**Learning Goal 2:** Use numbers in daily experiences

<table>
<thead>
<tr>
<th>Key knowledge/skills/dispositions</th>
<th>Examples of what children’s learning and development look like...</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rote count to at least 10</td>
<td>• Recite number names in the right order in rhymes or songs</td>
</tr>
<tr>
<td>• Count reliably up to 10 things</td>
<td>• Count in one-to-one correspondence (i.e. touch 1 object at a time when he/she says the number name)</td>
</tr>
<tr>
<td>• Compare the quantities of two sets of things and use ‘more’, ‘less/few’ and ‘same as’ appropriately</td>
<td>• Compare 2 groups of objects and recognise 1 group is more than the other</td>
</tr>
<tr>
<td>• Match number name/numeral/number word to the quantity of a set of things (within 10)</td>
<td>• Use language such as ‘more than’ or ‘less’ to compare 2 groups of objects</td>
</tr>
<tr>
<td>• Recognise that the quantity of a set of things is the ‘same’ irrespective of the starting point of counting</td>
<td>• Count readily when asked how many objects are in a group</td>
</tr>
<tr>
<td>• Recognise that the quantity of a set of things stays the same regardless of the arrangement</td>
<td>• Count and know quantity of real objects and abstract things (e.g. dots)</td>
</tr>
<tr>
<td>• Recognise numbers (1 to 10) in numerals and in words</td>
<td>• Match groups of ‘2’ in card games such as lotto or domino</td>
</tr>
<tr>
<td>• Form numbers (1 to 10) in numerals</td>
<td>• Represent number quantities in a variety of ways (e.g. using objects, fingers, base-10 blocks, ten frames, tally marks)</td>
</tr>
<tr>
<td>• Name parts that form the whole in quantity (e.g. 2 and 3 makes 5)</td>
<td>• Say the same total number of objects presented in different arrangements such as lines, arrays, circles and random arrangements</td>
</tr>
</tbody>
</table>

**Note:** The examples of children’s learning and development are neither age-specific nor exhaustive. Teachers have the flexibility to provide appropriate learning opportunities based on their children’s abilities, interests and developmental needs.
The teacher uses a counting board which provides a context for children to practise their rational counting.
The table below shows examples of activities that can be planned for learning goal 2.

<table>
<thead>
<tr>
<th>Key knowledge/skills/disposition</th>
<th>Learning objectives</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rote count to at least 10</td>
<td>Rote count from 1 to 5</td>
<td>• Use number rhymes such as “1,2,3,4, 5, Once I Caught A Fish Alive” and “1, 2 Buckle My Shoe” for children to recite the numbers in order.</td>
</tr>
</tbody>
</table>
| Count reliably up to 10 things    | Count reliably up to 5 things | **Count 5 objects in a set:**  
  • Provide several plates of 5 counters. Ask children to count the counters on each plate by moving the counters to an empty plate. This helps them keep track of what have been counted and what have not been counted.  
  • Place 1 counter in each box. This helps children focus on the concept of one-to-one correspondence. 
  • Count 5 objects in picture cards where children can touch but not move them.  
  • Close the eyes and count counters/objects being dropped into a tin by listening to the sounds. |

**Examples of Activities**  

Children count the number of cubes as they listen to the sound of the cubes being dropped into the tin.

**Count 5 objects from a large collection of objects:**  
• Count and put 5 biscuits on a plate during snack time.  
• Count and give 5 crayons to each friend.  
• Sort links by colour and take 5 links from each group to make a bracelet.
<table>
<thead>
<tr>
<th>Key knowledge/skills/dispositions</th>
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</tr>
</thead>
</table>
| Compare the quantities of 2 sets of things and use ‘more’, ‘less/few’ and ‘same as’ appropriately | Compare the quantities of 2 sets of things and use the word ‘more’ appropriately | • Pair the children and give each child a bag of counters and a paper plate. Each child grabs some counters from the bag and places them on the plate. Compare to see who has more counters on their plate.  
• Place domino blocks facedown and flip over 2 of them to compare which block has more dots.  
• After the children are able to compare and know which set has more or less counters, they can begin to determine the difference between 2 sets. Keep the difference between the 2 sets small (e.g. 1, 2 or 3). |
| Match number name/numeral/number word to the quantity of a set of things (within 10) | Match number name ‘5’ to the quantity of a set of things | • Say a number name (e.g. ‘5’) and ask the children to give you a set of 5 counters.  
• Look for groups of objects and numeral ‘5’ in magazines or supermarket advertisements and create a Number Book on ‘5’.  
• Match number word ‘five’ to the quantity of a set of things |
| Recognize that the quantity of a set of things is the ‘same’ irrespective of the starting point of counting | Recognise sets of 5 objects | • Divide the class into small groups. Give each child a picture card which consists of 5 objects. Assign each child in the group different starting points to count and then get them to tell you the quantity. |
| Recognise that the quantity of a set of things stays the same regardless of the arrangement | Identify sets of 5 objects in various arrangements | • Create different arrangements using pegs in varying quantities on the pegboard. Ask children to identify sets of 5 pegs.  
• Prepare cards of various quantities in different arrangements. Ask children to pick cards that show 5 dots. Examples of 5 dots in different arrangements: |

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<table>
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</tr>
</thead>
</table>
| Recognise number (1 to 10) in numerals and in words | Recognise numeral ‘5’ | • Conduct a number tour around the neighbourhood/within the pre-school centre to look for numeral ‘5’.  
• Provide some magazines and go on a number hunt for the numeral ‘5’.  
• Play a missing number game. Hide the numeral ‘5’ card from a number line and ask children to identify the missing number.  
• Do a number line-up using numeral cards. |
| Recognise number word ‘five’ | | • Give children some number word cards. Call out a number name at a time and children who are holding that number word card will stand up. |
| Form numbers (1 to 10) in numerals | Form numeral ‘5’ | • Form numeral ‘5’ using play dough. |
| Name parts that form the whole in quantity (e.g. 2 and 3 makes 5) | Identify the parts that make 5 | • Pair the children and give each of them a bag of 5 cubes. One child will take some cubes from his bag and the other child will have to take the correct number of cubes from his own bag to make 5.  
• Tell a number story using objects such as cars and a counting board to represent the setting for the story such as a scene of a road. For example, 2 green cars are on the road. 3 red cars are on the road. There are 5 cars on the road. |
Learning Goal 3

Learning Goal 3: Recognise and use basic shapes and simple spatial concepts in daily experiences

<table>
<thead>
<tr>
<th>Key knowledge/skills/dispositions</th>
<th>Examples of what children’s learning and development look like...</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Recognise the four basic shapes (i.e. circle, square, rectangle and triangle)</td>
<td>• Recognise and name the four basic shapes in their classrooms and immediate environment</td>
</tr>
<tr>
<td>• Use the basic shapes to form other figures (e.g. use 2 squares and a triangle to form a boat)</td>
<td>• Trace a variety of shapes</td>
</tr>
<tr>
<td>• Name position (i.e. top/bottom, in front of/behind), direction (i.e. up/down, left/right) and distance (i.e. far/near)</td>
<td>• Recognise shapes of different sizes in a picture</td>
</tr>
<tr>
<td></td>
<td>• Use manipulatives such as blocks, pattern blocks and tangrams to make simple figures from basic shapes</td>
</tr>
<tr>
<td></td>
<td>• Use words such as top/bottom and in front of/behind to describe the position of an object</td>
</tr>
<tr>
<td></td>
<td>• Use words such as left/right and far/near to describe direction and distance during motor skills or music and movement activities</td>
</tr>
</tbody>
</table>

Note: The examples of children’s learning and development are neither age-specific nor exhaustive. Teachers have the flexibility to provide appropriate learning opportunities based on their children’s abilities, interests and developmental needs.

The child explores with blocks of various shapes to build structures and uses words and phrases, such as “below” and “on top of”, to describe the position of the blocks as he stacks them.
**Examples of Activities**

The table below shows examples of activities that can be planned for learning goal 3.

<table>
<thead>
<tr>
<th>Key knowledge/skills/dispositions</th>
<th>Learning objectives</th>
<th>Activities</th>
</tr>
</thead>
</table>
| Recognise the four basic shapes (i.e. circle, square, rectangle and triangle) | Recognise and name the shape (i.e. square) | • Go for a neighbourhood walk and ask children to identify things that are square in shape.  
• Search magazines and newspaper for pictures of things that are square in shape. Cut and glue them on papers to make a book about squares. |
| Recognise and name the shape (i.e. squares in different sizes) | • Identify all the square blocks of different sizes from a bag of pattern blocks. |
| Recognise and name the shape (i.e. squares in different orientations) | • Get children to rotate a square pattern block on the paper and trace its outline. Guide them to make a few rotations and trace the outlines. Encourage them to compare the outlines with a friend and talk about how they are created. |
| Use basic shapes to form other figures (e.g. use two squares and a triangle to form a boat) | Use basic shapes (i.e. squares) to form other figures | • Use pattern blocks to form other figures such as two triangles to form a square or rectangle.  
• Form a figure by placing small coloured square pieces of paper on a piece of drawing paper. |
| Use basic shapes to form a figure | • Use pattern blocks to create figures on a piece of plain paper and trace the figures. |
| Name position (i.e. top/bottom, in front of/behind), direction (i.e. up/down, left/right) and distance (i.e. far/near) | Name the position of objects (i.e. top/bottom) | • Go on a treasure hunt with the children using positional words. For example, “Open the box on the top shelf. Look for the tower of interlocking bricks at the bottom of the box.” |
Summary

Teachers can help children to work towards achieving the learning goals for numeracy by providing them with opportunities that allow them to develop essential pre-number, early number, shape and simple spatial concepts. These learning experiences should be well-planned to help children attain a firm foundation for mathematics learning.
Strategies for Numeracy

Learning of numeracy can occur throughout the day. It can be embedded in children’s daily routines and play. It can also be hands-on activities planned by the teacher. These activities can range from individual to small and large group activities.

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

- Asking questions
- Providing opportunities for children to solve problems
- Using stories, songs and rhymes
- Using games
Concrete-Pictorial-Abstract (CPA) Approach

As numeracy concepts are abstract, the Concrete-Pictorial-Abstract (CPA) approach provides an organisational structure to guide teachers in planning learning experiences which help children develop their understanding of these concepts. Teachers should plan learning experiences which help children move in sequence through and build connections between the phases of concrete, pictorial and abstract.

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

<table>
<thead>
<tr>
<th>Concrete</th>
<th>Pictorial</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Concrete" /></td>
<td><img src="image2.png" alt="Pictorial" /></td>
<td><img src="image3.png" alt="Abstract" /></td>
</tr>
</tbody>
</table>

- Model counting concrete and real objects such as apples, blocks, cubes, boxes, buttons, toys and fingers.
- Allow children to count objects in a set and count objects from a large collection of objects. Let them touch and move the concrete objects as they count them.
- Provide other counting experiences such as counting objects that are in a distance where children can see but cannot touch them and counting coins from the sound they make when dropped into a tin.

- Model counting objects representing concrete objects in pictures after the children have mastered understanding on the concrete level.
- Provide opportunities for children to create their own pictures as models for counting.
- Use dots and tallies as visual representations of the concrete materials where children can touch and not move them.
- Use symbols such as numerals to represent the picture of objects or number of dots.
At each phase of the CPA approach, the teacher plays an important role in selecting and using appropriate strategies (e.g. asking questions and using stories and games) to promote numeracy development.

**Asking Questions**

Children should be encouraged to talk about and share with others how they have completed a task or solved a problem. These opportunities allow them to verbalise and clarify their thinking which in turn helps them develop their understanding of numeracy concepts. Teachers can facilitate this process through questioning.

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

- It’s 5. 4 cubes and 1 more.
- It’s 5. I counted them – 1, 2, 3, 4, 5.
- It’s 5. I know it is 5.
The contexts in which questions can be asked range from incidental comments about quantity during daily routines such as snack time (e.g. “How many biscuits did you place in your plate?”) to planned activities such as an art and craft activity (e.g. “What is the pattern that you have created on the picture frame?”).

The table below provides examples of questions that teachers can use to scaffold children’s learning of various concepts or challenge them to the next level of thinking in planned experiences.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Questions</th>
</tr>
</thead>
</table>
| Sorting | • How do you sort these objects?  
• How are they alike? How are they different?  
• Are there any other ways to sort these objects?  
• I wonder why this object doesn’t belong here. What do you think?  
• Can I put any of these objects in this group? Why do you think so? |
| Patterning | • What comes next/before/after this …?  
• Is there a pattern on …? How do you know?  
• Why do you put this pattern block here?  
• What pattern did you create? Tell me about your pattern.  
• What other patterns can you create? |
As children manipulate and play with different materials, teachers can provide them with the language to articulate and discuss their ideas, ask questions and stimulate their thinking.
Providing Opportunities for Children to Solve Problems

Children should be given opportunities to explore concepts and think of different ways to solve problems they encounter in their daily routines. Teacher may also pose problems by asking questions such as:

- How many triangular shapes can you form with 9 ice-cream sticks?
- How many objects in the classroom can you find that is longer than this ice-cream stick?
- If you have 5 ice-cream sticks, how many different ways can you arrange them? Can you draw the different ways?

George Polya’s (1973) 4-step method could be considered in facilitating 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 it is they are looking for or trying to solve, they can think about how they are going to solve the problem and devise a plan to reach that goal.
- **Step 3: Carry out the plan** - When children have selected a plan/strategy, they can carry it out to find the solution to the problem.
- **Step 4: Look back** - When children have completed their work, they can look back and justify their answer or solution to the problem.

**Example**

Questions: How many figures can you form with 5 ice-cream sticks? Can you draw the different figures?

- **Step 1: Understand the problem** - Children have to understand the quantity of 5. They will use only 5 ice-cream sticks to form as many figures as possible. They will have to make a drawing of each figure.

- **Step 2: Devise a plan** – Once the children know what they have to do, they will think about what they need and how they will go about rearranging the ice-cream sticks to create as many different figures as possible.

- **Step 3: Carry out the plan** – When the children have decided how they are going to arrange the ice-cream sticks, they can make as many different figures as possible and record the figures through drawing or by taking pictures of the different figures.

- **Step 4: Look back** – After the children have completed their work, they can look back and share with their friends the different figures that can be formed with 5 ice-cream sticks and explain how they created them.

It is important to provide time for children to observe, think and try out different ways to solve a given problem. The children should not be rushed through the learning experience. They should be encouraged to engage in sustained periods of thinking. Consequently, they will experience success in problem-solving and become more determined in their efforts to look for solutions to problems.
Using Stories, Songs and Rhymes

Stories can be used to set meaningful contexts for the learning and understanding of numeracy concepts. Books should be carefully selected with illustrations that accurately portray the concepts. Teachers can use questions to highlight the numeracy concepts and then relate the concepts to children’s daily experiences.

The teacher uses stories such as “The Very Hungry Caterpillar” by Eric Carle to set the context for introducing the number 5.

The teacher asks questions like:
- How many oranges did the caterpillar eat?
- Do you eat 5 oranges a day, just like the hungry caterpillar? Why? Why not?
- Which fruit can you eat more than 5 a day?
Other books such as picture counting books or books focusing on a numeral should also be included at the Reading Centre for children to count independently or with a friend.

Songs and rhymes can also be used to make learning of numeracy concepts more relevant and enjoyable. Singing songs or reciting rhymes with actions, such as “Five Little Monkeys Jumping on the Bed” and “Five Little Ducks Swimming in a Pond”, allow children to develop and practise their counting skills.

**Using Games**

Games make it more interesting and enjoyable for children to practise recently acquired skills and concepts. For example, children can count pictures of objects, squares on a route, or dots on a die in a game. This allows them to experience counting in a variety of different settings which help them move from the “touching each object” stage to the immediate recognition of a group. Recognition of various shapes within a game situation engages children in learning through purposeful play.

The child counts the dots on domino pieces as he plays the game. This helps him to reinforce recently acquired counting skills.
Summary

Children learn numeracy concepts and skills by investigating, comparing and talking about what they are doing. In designing numeracy activities, teachers should also make provisions for children to make connections and see relationships between the various numeracy concepts and skills that they have learnt in the classroom and how they are used in their everyday lives.
Organising the Learning Environment

The organisation and arrangement of the learning environment has an impact on children’s behaviour and their learning. A learning environment filled with resources and activities encourages children to explore, interact and have meaningful discussions about numeracy concepts. It also arouses and sustains children’s interest in exploring concepts independently or in groups. It invites children into discussions about what and how they think in the process of discovering solutions and answers.
Resources that Support Numeracy

Resources play an important role in supporting children’s learning as they provide children with the concrete experience they need to learn the various numeracy concepts and skills. They may be used for self-directed or teacher-directed activities. Resources used for teacher-directed activities serve to illustrate the concepts and skills being taught. Resources for self-directed activities provide opportunities for children to explore, practise and extend their understanding.

Careful selection and organization of resources are essential for successful explorations. Resources 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. Teachers can consider the following questions as they plan to create a learning environment that supports the children’s learning process:

• What are the learning objectives?
• What are the numeracy concepts/skills children should learn?
• What activities will take place?
• What resources need to be available?

The table below shows some examples of resources that can be used to facilitate the learning of various numeracy concepts.

<table>
<thead>
<tr>
<th>Resources for matching, sorting, comparing, ordering, patterning and counting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Counters</strong></td>
</tr>
<tr>
<td>Counters are sets of small plastic objects such as “bears”, “dinosaurs” and “fruits” which come in 4 or 5 different colours. Natural materials such as seeds from non-poisonous plants, leaves, pebbles and stones, and objects such as buttons, bottle caps, bread tags, and keys, can also be used as counters.</td>
</tr>
</tbody>
</table>
Counting Boards

Counting boards provide meaningful contexts for children to practise their counting skills. For example, if a child chooses a set of birthday cake counting boards, he/she could use candles and count them as he/she prepares the cakes for his/her friends in his/her group.

Unifix Cubes

Unifix cubes usually come in 10 different colours and 10 cubes of each colour. Fixing cubes of 2 different colours can be used to facilitate the understanding of the part-whole relationship of a number.

For example, give children some red and yellow cubes and ask them to create towers of 5. They can look at each other’s towers and describe their towers of 5 in terms of how they are made up of 3 green cubes and 2 red cubes or 1 blue cube and 4 yellow cubes.
Beads and Laces
Stringing beads of different colours can also be used to emphasise the part-whole relationship of a number where children can describe their sets of 6 as 2 green beads and 4 yellow beads or 1 blue bead and 5 red beads.

Dice
Dice are small cubes marked on all sides with dots or numerals. They can be used in board games or teacher-created activities. For example, the teacher rolls the die and children show the number of counters based on the number of dots shown on the face of the die.

Resources for basic shapes and simple spatial concepts

Pattern Blocks
Pattern blocks can be made of wood or plastic. They usually come in 6 colours and different shapes. Children can use these blocks to explore and create different figures.
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 use these geometric shapes to form different figures.

Geoboards

Geoboards are plastic or wooden boards with pegs arranged in an array. Children can use rubber bands to form various shapes on the geoboards.

Building Blocks

Building blocks are small coloured blocks which are frequently used for table activities. Children can use these blocks to construct various figures and help them understand the relationship between objects and their locations.
Interlocking Bricks

Interlocking bricks come in different colours and they are frequently used for table activities. Children can use these bricks to explore and create various figures/models.

Other resources

Number Lines

Number lines can be used as a tool to reinforce what the children know about numbers. For example, children may be encouraged to find the number on the line which matches their number of blocks, or the number of biscuits they have on a plate.

It can also be used to teach counting and ordering of numbers. For example, remove selected numerals from the number line and get children to fill in the missing numeral.

Five and Ten Frames

Five and ten frames are equal-sized rectangular boxes in a row where each box is large enough to hold a counter. Using a ten-frame and two-coloured counters, children can easily see that 6 is 1 more than 5 and 4 less than 10, or that 8 can be seen as “5 and 3 more” and as “2 away from 10.” Once children are able to visualise the numbers 1 to 10, they begin to develop mental strategies for manipulating those numbers, all within the context of the numbers’ relationship to ten.
Learning Centres that Support Numeracy

Resources and tasks can be placed at learning centres to encourage active participation by children. At the learning centres, children can use and apply their numeracy concepts and skills at the Water Play Centre, at the Dramatic Play Centre or while working with play dough at the Art and Craft Centre. This helps them to make links across different areas of learning and realise that the skills they are developing are transferable.

The child uses dough at the Art and Craft Centre to explore and make strands of noodles of different length.
Construction/Block Play Centre

Construction with blocks/scrap materials encourages children to explore shapes, size, position and direction. For example, children can use various construction materials to build houses for the puppets at the Dramatic Play Centre. After the houses are built, children can reflect on questions such as “Can the puppet fit into the house that you have built?” or “How many puppets would fit in one house?”

Manipulatives Centre

At the Manipulatives Centre, children explore using manipulatives such as counters, unifix cubes, beads and pattern blocks to revisit concepts and practise skills. For example, children learn to tell one shape from another by handling different pattern blocks. They can match the shape of the blocks together or sort the blocks according to colour, shape or size.
Summary

A numeracy-rich environment provides children with resources and experiences to explore concepts and develop new skills. It should also arouse and sustain children’s interest and support their thinking and learning process.

Dramatic Play Centre

Dramatic play encourages children to use numbers in contexts that are authentic and relevant to them. For example, a bakery shop can be set up for children to experience selling and buying of cupcakes, biscuits and doughnuts in different quantities.

Dramatic Play Centre provides opportunities for children to practise and use numeracy concepts and skills in contexts that are meaningful and relevant to them.
Children come with different prior knowledge and they learn and develop at different pace. Observing children over time helps teachers to be aware of their varying levels of understanding of numeracy concepts and skills. It allows teachers to determine what children know and the difficulties they face. This information could form the basis for focused and improved teaching practices such as varying the level of difficulty of a learning activity to meet the different needs of children.
Observing and Documenting Children’s Learning

Documentation of children’s learning and understanding of numeracy concepts and skills can be guided by a series of questions.

What happened at a learning activity?

What did I learn about the child?
- What does the child already know?
- What has the child learnt?
- What are the difficulties the child is facing?

What can I do?
When children are working with pattern blocks to create AB patterns, some questions that teachers can bear in mind to ascertain children’s understanding and progress include:

• Can they recognise patterns?
• Can they copy patterns?
• Can they recognise and extend patterns?
• Do they extend patterns consistently?
• Do they lose track of the pattern as they make them longer?
• Can they create their own patterns using colours or other attributes?
• Can they interpret patterns based on colour or other attributes?

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

• Do they use the correct counting sequence to count objects?
• Do they count each object only once?
• Do they have a way of keeping track of what they have counted?
• Can they count correctly when asked to get a set of objects?
• Are they able to count correctly regardless of the arrangement of the objects?
• Are they able to identify small sets of up to 4 or 5 objects instantly?
• Can they say a number name and give a corresponding set to it?
• Can they determine whether one set of objects is more than, less than or the same as the other set?
• Can they determine how many more or how many less one set of objects is compared to the other set?
• Do they know the parts of a number?

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 identify each shape in different sizes?
• Are they able to identify each shape in different orientations?
• Are they able to distinguish and describe those attributes that define the shape?
Example 1

Context:
Ali, Bala and Cai Ling were encouraged to use two different coloured beads to create friendship bands with AB patterns.

Teacher’s Anecdotal Record:
- Ali very quickly formed a friendship band with alternating red and blue beads for Bala.
- He asked whether he could create another band for Cai Ling.
- When asked what he had created, he tried to explain what he had done: red bead, red bead, blue bead, blue bead, red bead, red bead, red bead, blue bead, red bead, blue bead, red bead.
- The band he created showed that he was trying to create a more complex repeating pattern, AABB, but was unable to keep track of it.

Possible Interpretation/Assessment:
- Ali shows that he is able to create simple repeating patterns such as the AB pattern.
- Ali is beginning to experiment with more complex repeating patterns such as the AABB pattern.

What the Teacher Could Do:
- Show Ali more examples of complex repeating patterns and ask him to identify and extend the pattern.
- Provide other opportunities for him to create these complex patterns such as decorating a photo frame.

Documentation:
Teacher could document Ali’s progress by including photographs of friendship bands and photo frames he had created and include observation notes to show:
- Ali’s ability to create simple repeated patterns, i.e. AB pattern
- His progression and increased accuracy in creating more complex patterns
Example 2

Context:
Jia Ying and Shawn were role playing at the Dramatic Play Centre. Shawn pretended to be the baker trying to sell cakes and biscuits to Jia Ying. Teacher gave Jia Ying a list of biscuits and cakes to buy from Shawn. She encouraged Shawn to place the number of biscuits and cakes listed on a tray.

Teacher’s Anecdotal Record:
• Shawn could pack quantities up to 4 objects and showed some inconsistencies in packing 5 objects. He was accurate in his counting 2 out of 5 times when he packed 5 objects on the tray.
• When he counted and placed 1 biscuit at a time onto a tray, he could get the correct number of biscuits. But he would derive a different answer when he has to count the biscuits or cakes on a tray as he could not keep track of the starting point.
• Jia Ying could count reliably up to 5 and was able to tell Shawn that he did not place the right number of biscuits or cakes for her a few times.

Possible Interpretation/Assessment:
• Shawn is able to count objects reliably up to 4.
• He is able to count objects reliably up to 5 when he can move them.
• He has difficulty in counting objects when he cannot move them.
• Jia Ying is able to count objects reliably up to 5.

What the Teacher Could Do:
• Provide Shawn with more opportunities to count objects without moving them.
• Provide some tips for him to keep track of the starting point by putting something on it or use a pencil to mark it.
• Provide Jia Ying with opportunities to count beyond 5 objects and extend her learning by requiring her to compare sets of 5 or fewer objects and determine which set has more or less objects.

Documentation:
Teacher could document the progress of Shawn and Jia Ying by including a series of photographs of the various counting activities and observation notes to show:
• Shawn’s ability to count objects reliably up to 5 without moving the objects
• Jia Ying’s ability to count objects reliably up to 5
Example 3

Context:
Ali and Jia Ying were playing with pattern blocks at the Manipulatives Centre. Each child was given pattern blocks of different shapes and encouraged to use them to create figures.

Teacher’s Anecdotal Record:
• Jia Ying did not use the blocks to create figures with her friends.
• She gave Ali square blocks when he asked her for some rectangular blocks.
• She told Ali that she did not have any square blocks when he asked her the second time, although she was still holding on to two of them.
• Jia Ying said that she liked the big blocks at the nearby Construction/Block Play Centre.

Possible Interpretation/Assessment:
Both the children’s conversation and verbal and non-verbal responses from Jia Ying provided a good source of evidence of her thinking and progress.
• Jia Ying seems to have difficulties in distinguishing between a square and a rectangle.
• Jia Ying seems to be more interested to play with the materials at the Construction/Block Play Centre.

What the Teacher Could Do:
• Rotate Jia Ying and her group to the Construction/Block Play Centre and provide only square blocks/cubes and rectangular blocks in various sizes for her to continue to explore these two shapes.
• Jia Ying needs to be given opportunities to experiment with different types of blocks and explore how a square is different from a rectangle.
• Facilitate the play by providing the names of the shapes as she handles and uses the various blocks. Highlight and invite her to talk about the similarities and differences between these two shapes.

Documentation:
Teacher could document Jia Ying’s progress by including a series of photographs of her at the Construction/Block Play Centre and observation notes to show Jia Ying’s ability to distinguish a rectangle from a square.
Summary

Observing and assessing children’s learning is an important process for the teacher to be aware of what they already know. This information helps the teacher to pace the support for children’s learning as well as to plan activities that reinforce or extend their learning of numeracy concepts and skills.
Bibliography


