

Beyond Centers & Circle Time

Curriculum Theme Series

Mathematical Thinking and the Pre-School Child

In the past two decades, the view of young children and what they are capable of learning has expanded. States now have standards for children birth through five and early childhood programs are facing more stringent requirements for child outcomes and program implementation. The fear of many early childhood educators is that, in this stampede to improve education outcomes and program quality, the essence of how young children learn best will be overlooked and possibly lost.

The brain research has clearly broadened our awareness of the capabilities of young children, but how young children acquire knowledge that will be used to build a foundation of skills and processes that can be accessed for success in later school has not changed. Young children learn best in happy, loving, environments that support their exploration and discovery of knowledge. The National Association for the Education of Young Children (NAEYC) and the National Council for Teachers of Mathematics (NCTM) adopted a position statement concerning early childhood mathematics in 2002. The following quote is taken from that position statement:

Throughout the early years of life, children notice and explore mathematical dimensions of their world. They compare quantities, find patterns, navigate in space, and grapple with real problems such as balancing a tall block building or sharing a bowl of crackers fairly with a playmate. Mathematics helps children make sense of their world outside of school and helps them construct a solid foundation for success in school.

Young children do not learn in discrete categories such as science, math, writing, or reading. There is much research to suggest that older children would learn more in environments that connect subjects in a more holistic manner such as John Dewey suggested over 100 years ago. Young children learn best when more than three of the up-front senses (sight, sound, touch, tasting, and smell) are engaged. The more senses involved, the more learning takes place. Multi-sensory experiences help children develop multiple pathways that will provide more places in the brain where information is stored. This process makes later retrieval more probable.

Mathematical thinking is much more than recognizing numerals or counting objects on a worksheet. It involves a complex system of knowledge of objects and their relationships, the ability to solve problems, compare and contrast information, and see and create patterns. When young children experience math concepts in a playful and learning rich environment they discover their use and value. This in turn creates the foundation for all later mathematical literacy.

There is no question that young children have the ability to develop this foundation for mathematical literacy. The real problem is teaching educators the skills and knowledge needed so that they can create environments that will offer experiences that will enhance children's mathematical thinking and extend their opportunities to discover. Most early childhood classrooms are planned and implemented by women and many women do not feel comfortable with number concepts. Of all the content areas provided in the pursuit of a degree outside of high school, math appears to create the greatest obstacle. Many early childhood educators, because of this fear of mathematics, do not easily and enthusiastically include mathematical thinking experiences in their daily routines.

The Beyond Centers and Circle Time Curriculum Theme Series provides early childhood educators with easy to implement daily experiences that are designed to offer children opportunities to explore materials and discover mathematical knowledge. Counting, sorting, classifying, creating patterns, measuring, and just playing with numerals are a part of each day's lesson plan. This Math Supplement offers additional ideas of experiences that can be substituted or exchanged to add more density to these daily plans. Incorporating experiences that will support young children's acquisition of mathematic knowledge is easy and can be a lot of fun.

Math Vocabulary for Early Childhood Teachers

Sets of

Equal/equivalency

Length

Width

Height

Horizontal

Vertical

Diagonal

Parallel

Number words one through one hundred

Ordinal numbers first through tenth

Positional words—over, under, behind, beneath, on top, between, beside, in front of, below

One half

One quarter

Whole

Even

Odd

One-to-one correspondence

Inches

Feet/foot

Yard

Classify

Organize

Pattern/s

Geometric flat shapes—triangle, square, circle, ellipse, rectangle, oval, rhombus, trapezoid

Two-dimensional

Geometric solid shapes—cylinder, cube, sphere, ellipsoid, pyramid, cone

Three-dimensional

Adding

Subtracting

Measuring

Symmetrical/non-symmetrical

More

Less

Heaviest

Lightest

Shorter

Longer

Tally

Celsius

Fahrenheit

*This is not an exhaustive list. Many other words can be added.

Developing Basic Number Sense

Understanding One-to-One Correspondence



In **mathematics**, one-to-one correspondence refers to a situation in which the members of one set or group are evenly matched with the members of a second set or group. When objects in a group or set are evenly matched it means that each member of one set is paired with one and only one member of the other set.

When young children first begin to count objects they usually say the number words as they randomly touch the objects being counted. They will often touch two objects as they speak only one number and continue reciting number words past the last object. In order to count accurately, children must learn that each word must be matched with the object being counted and that they must stop counting when all the objects have been touched.

- Children are offered opportunities to discover the importance of one-to-one correspondence when they are provided opportunities to arrange chairs around tables or invited to pass out napkins or cups, ensuring that each child receives the required amount.
- When an early childhood educator touches each object as a set is counted, he/she is demonstrating one-to-one correspondence. Encouraging children to touch each object as it is counted further underscores this concept.
- During play, when a child places the dishes around the table for an imaginary dinner and a plate, cup, spoon, etc. are placed in front of each chair he is practicing one-to-one correspondence.

- At meals, circle times, or whenever appropriate, children can help demonstrate this concept by counting the number of children in the group. When a child is allowed to move around the group touching each child as the group counts, this concept is practiced and made meaningful.
- On the playground or in the sand area, children help set up the environment by arranging a bucket, shovels, and sieve for each child.
- A child puts on his shoes and socks (one sock, one shoe, one foot)
- When a child has made a string of beads or a stack of blocks, he can be encouraged to count the number used by touching each bead or block as the number word is stated. The adult should scaffold the counting as needed for the child to be successful. (Ex: Offering number words as necessary. Helping the child touch only one object as the number word is spoken.)
- As a group of children enters the building from the playground they can count the steps they climb to the door or count the steps they take up the walk or ramp. Stepping in a dramatic, demonstrative manner while counting out loud helps children gain control over their bodies as they move from free activity to a more settled experience inside and allows them to play with the names of numbers as they pound their feet.

Understanding How To Count, Construct, and Compare Sets

Learning the number words and how to create and compare sets takes time and experience. Early childhood educators must make counting fun and meaningful throughout each day. Remember we are creating a foundation on which the children will build all their later mathematical knowledge. Their early experiences must be planted strongly in meaningful experiences that are risk

free and provide continuous opportunities for practice. **Work sheets are not appropriate.**

- Early childhood classrooms are filled with objects that lend themselves to counting experiences. Counting the number of children as each experience is begun, counting the number of books, cups, etc. that are needed so that each child can participate helps children depend on the use of number concepts just to get through the day.
- Learning finger plays and singing number songs such as “Five Little Speckled Frogs” and “There Were Ten In The Bed” provide children with fun ways to use number words and count sets using their fingers. Early childhood catalogs have numerous tapes, CD's, and books that support the counting of objects, the use of ordinals, and the combining and removing objects from sets. Children love music and many children learn subject content through music and movement experiences. **Remember, when it is fun the child's brain opens and learning becomes possible.**

Five Little Speckled Frogs

Written By: Unknown - Copyright Unknown

Five little speckled frogs (Hold five fingers [frogs] on top of your arm [log])

Sat on a speckled log

Eating their most delicious lunch. Yum! Yum!

One jumped into the pool (jump a finger off the log into the pool)

Where it was nice and cool

Now there are **Four** little speckled frogs (Hold up four fingers)

Four little speckled frogs

Sat on a speckled log

Eating their most delicious lunch. Yum! Yum!

One jumped into the pool

Where it was nice and cool
Now there are **Three** little speckled frogs
Three little speckled frogs
Sat on a speckled log
Eating their most delicious lunch. Yum! Yum!
One jumped into the pool

Where it was nice and cool
Now there are **Two** little speckled frogs
Two little speckled frogs
Sat on a speckled log
Eating their most delicious lunch. Yum! Yum!
One jumped into the pool

Where it was nice and cool
Now there is **One** little speckled frog
One little speckled frog
Sat on a speckled log
Eating his most delicious lunch. Yum! Yum!
He jumped into the pool
Where it was nice and cool.
Now there are **NO** little speckled frogs

Ten in a Bed

Written By: Unknown - Copyright Unknown

Count ten children and have them to sit in ten chairs. Ordinals can be added to this experience when the adult points out that the child in the first chair is going to be the first to fall out of the bed. Allow room on the floor for the children in the chairs to safely fall out of bed. At the end of the song the "Little One" is left as the last one in the bed. He/She is the tenth. The children on the floor and in the group can call out, "Wake up,

“Little One” and the little one can fall out of the bed (last chair) leaving it empty. The children in the group should have been using their fingers to count down as each one fell out of the bed.

And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were nine in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were eight in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were seven in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were six in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were five in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were four in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were three in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There were two in a bed
And the little one said
"Roll over, roll over"
So they all rolled over
And one fell out

There was one in a bed
And the little one said
"Good night!"

- Children construct sets using structured construction materials such as unit blocks or hollow blocks. Building with structured construction materials can help children develop counting skills if adults support them and encourage them to count the number of shapes they used to create a structure.

This must be fun and not a test or chore.

If one child uses 12 columns and another uses 8, an opportunity to discuss more and less is provided and the answer can be checked for correctness by placing the blocks from one structure when it is taken down with the same kind of blocks in the other: Which used more? Which used less?



- During the sharing circle each morning count the number of children present. Separate the children into a group of boys and a group of girls. Are there more girls present or more boys (comparison)? A graph can be made with the children's names written on tag board strips. The girls can place their names in one column and the boys in another on a sentence strip holder. This allows for an easy visual comparison. If name cards aren't used, a horizontal or vertical graph can easily be made on graphing paper by letting each child present color in a square. If the same color is used for the boys and another for the girls a clearer visual pattern is created.

As centers such as cooking and art begin a similar experience can be provided.



Adults should write the numerals for each column so that the children have daily experiences with quantities and the number symbols that represent them.

Numerals should be a part of as many daily experiences as possible. Adults should write the numerals that represent the quantities under discussion. The more opportunities children have to use number concepts the more comfortable they will become with mathematical thinking. **Worksheets are not appropriate.**

Understanding Ordinals

Adults should use ordinal positions whenever possible. For example when discussing the beads a child has strung on a lace say, "The blue sphere is first, the green cube is second, and you started again with the blue sphere. It is third and that makes the green cube the _____." As children hear number words and ordinal words spoken as meaningful experiences are discussed, they begin to understand their use and importance. **It is the daily casual use of number concepts that make them a part of a child's life experience.**

Use ordinal words continuously throughout the day. This is a habit adults who work with children should develop. "Oh, look. The red truck is first and the green truck is second." Or "Charlie is the fifth friend at the table and Tamaya is the sixth." **Ordinal words should roll off your tongue whenever it is possible.**

Understanding Numbers And Number Operations

Combining objects and taking objects away from a previously created set should be practiced everyday. During the morning sharing circle when the adult discusses the fact that there are 18 children in the class. The children will discover who is present and who is absent. This is a perfect opportunity to practice taking away. The number sentence can even be written on the chalk or dry erase board. (18 friends – 2 friends (Jack & Ahmad) = 16 friends) Do not expect the children to write this number sentence or memorize it. By writing it for them, you are exposing them to the concepts.

- Count objects, blocks, children, and foods throughout each day. “How many different foods do we have to eat for lunch?”
- When using a floor puzzle such as “Farm Animals” encourage the children to count the different sets of animals seen in the puzzle picture. Provide them with a number line so they can easily copy the needed numerals and a clipboard with pencil and paper. **Do not correct their efforts to write. You want them to practice and in order to practice they must feel safe. Create a risk-free environment.**
- When you count the number of boys in the circle or activity and you count the number of girls you can compare the two groups. “Which has more, the group of boys or the group of girls?”

Using Patterns, Classification, and Seriation

As young toddlers, children begin to classify toys. They usually classify objects by color, then shape, and finally by size. This ability to order objects requires that children compare the attributes of objects and organize them according to those attributes.



Unit blocks should be organized on shelving with pictures of the shapes and words that name the shapes. The organization should allow children opportunities to practice seriation when placing the block pieces on the shelves. Each time children replace the blocks on the shelving they are practicing their classification skills. Organize colored wooden blocks in labeled bins by color.

A classifying mat can be made or purchased. Buttons, bottle caps, or purchased items designed to encourage classification can be used. Encourage the children to explain the process they used to classify the items. When the items have been classified provide the children with paper, pencils, and a number line so that the numerals can be easily copied. Encourage the children to count and list the amount of each item classified.



Provide children daily opportunities to create patterns using beads and laces, pegs and pegboards, buttons, and shells. Early childhood play material catalogs have numerous materials that support the development of children's patterning and classification skills.

Adults should call attention to patterns created by children, encouraging them to explain their process. Unit blocks provide opportunities to create symmetrical and non-symmetrical constructions. Providing discussion opportunities allow children the chance to explain their thoughts and receive recognition from their peers.

Educators should pay attention to patterns as they arrange the chairs of different colors around tables, plant flowers in gardens, and hang pictures for display. Patterns make the environment appear more aesthetically pleasing and organized.

Understanding Geometry

The world is filled with shapes. Adults must provide children with daily opportunities to experience two-dimensional and three-dimensional shapes. The names of these shapes will become familiar to children when adults use the names and point out the shapes. Unit blocks are an excellent resource for providing children opportunities to explore three-dimensional shapes.

Pictures of buildings that accentuate certain shapes in their construction should be placed around the block play area. Books with shapes should be available for exploration.

The concept of symmetry can be presented using unit blocks and when children are allowed opportunities to build with unit blocks they can practice in their own structures. Early childhood educators must be prepared to point out symmetry in all constructions and products created by the children. It is the repetition over time of such concepts that provide children the opportunity to practice and fully understand.



Understanding Spatial Relations

In order for children to understand the uses of positional words such as above, below, beside, next to, inside, outside etc., adults must verbalize them whenever possible so that children can not only hear the words or see pictures in books, but can physically experience the positions whenever possible. The playground is a perfect place to help children understand these words. Look at your playground. Does it have a jungle gym? If so, how many position words can be experienced during play on it? Is there a slide to go down, stairs to climb up, an area to crawl under, a platform to stand above the other children on, or a tunnel to crawl through?

- Adults must be aware of opportunities to encode positional words during daily experiences inside and outside the classroom.

We can sit around the table.

We can walk through the door.

We can climb under the table.

We can stand beside the piano.

Johnny put the tigers inside his castle (in the unit block area).

Ride the tricycles around the path.

We go up the stairs and into the building.

We are inside now, but when we go out the door we will be outside.

Put your ham slice between your pieces of bread.

- Make an obstacle course that allows children to follow directions that use positional words.

Jump over the buckets.

Run around the flags.

Walk on top of the balance beam.

Crawl through the tunnel.

- Parachutes can provide many opportunities to allow children to practice their understanding of positional words.

Put the parachute over your head.

Put the parachute under your feet.

Walk under the parachute and sit down in the middle.

Walk around in a circle holding the edge of the parachute

The BCCT Curriculum Theme Series suggests numerous activities using a parachute for outdoor play.



- Play “Simon Says” using positional words in the directions. Example: Simon says. put the crayon below the chair, next to the book, on top of your head. Switch roles and let the child be Simon and give directions using similar positional words.
- Design a simple picture treasure map with classroom or playground landmarks and allow the children to find the treasure through reading the map.



- Introduce the concepts of horizontal and vertical by placing the easel paper horizontally (the fat way) or vertically (the tall way). Discuss the different things you might paint as the paper is placed horizontally and vertically. For example, a giraffe would fit better on the vertical paper and an elephant on the horizontal. A tall tree would fit best on the vertical paper and train on the horizontal paper. Once

the children understand the concepts you can ask them how they want their paper placed as they draw and paint.

- Use the words vertical, horizontal, and diagonal as you discuss children's block structures.
- Walk diagonally across the playground as you return to the building. Children love big words and physically experiencing them in movement helps them understand and retain their meaning.

Using Measurement



- While planting the new garden let the children measure the depth of the holes they dig for the plants and the distance between plants. Rulers can be used as a standard measure.
- Unit blocks provide many opportunities for children to measure and compare structures using pieces of block. Adults should regularly demonstrate how four unit blocks are equal to one quad or two units are equal to a double. The larger blocks can be placed end to end to measure something and then it can be measured again using smaller blocks. The children can be encouraged to estimate which size will need the fewest blocks to complete the measurement and which size will need the most.
- Children can stand next to the wall to measure their height using a standard Measure their height again using a non-standard measure such

as unit blocks. The children can again be encouraged to estimate whether more unit blocks or inches are needed.

- Classify, count and graph color bears, shells, number of boys, girls in the group, kinds of animals etc. Estimate what you'll have the most and least of.
- Collect weather data, rain amounts, number and kind of pets.

