



## Cultivating Mathematical Thinking in Young Children

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The extent of exposure to math concepts in early years predicts how well children will do in mathematics during the elementary years.

Exposure to math also predicts how well children will do in reading.

Children are eager to explore math, and they are capable learners of mathematical ideas.

### Components of Math

#### ❖ Number and Operations

- Children develop counting skills at very early ages.
- The easiest collections for a 3-year old to count are those in a straight line.
- From 3 to 5 years of age, children learn to count objects in larger sets and in different arrangements.
- Many 3-year-old children believe that two sets of objects have the same number if the objects are close to each other.
- By 4 years of age, children can develop a matching process so they can compare sets.
- 3 and 4-year-old children learn subtraction problems before they can solve addition problems.
- Children do not often understand mathematical words in a problem situation and require modeling with concrete objects and words to develop “operational sense.”

#### ❖ Geometry and Spatial Sense

- Children do not develop their ideas about shapes simply by looking at them. They must manipulate, draw or represent the shapes in various ways.
- 3- and 4-year olds typically judge shapes by appearance as a whole: that is, a triangle is a triangle because it “looks like one.”
- 3-year olds can build simple yet meaningful maps with landscape toys such as houses, cars and trees. Older preschoolers can learn relative distances between landmarks.
- Visualization and spatial reasoning are improved with interaction with computer animations and in other technological settings.

#### ❖ Measurement

- Young children know that attributes of length, weight, capacity and time exist, but they do not know how to reason about them or to measure them accurately.
- Children’s initial ideas about the size or quantity of an object are based on perception. They judge that one object is bigger than the other because it looks bigger.
- Four-year-old children can begin to learn the process of measuring with nonstandard units.

- Children can benefit from using rulers along with concrete models of units during beginning activities with measurement.
- ❖ Patterns (Algebra)
  - Very young children are interested in patterns and can learn to copy simple patterns made with objects.
  - Young children can determine the unit of a repeating pattern and can use this skill to determine that two perceptually different patterns actually have the same structure (e.g. red, blue, blue, red, blue and stomp, clap, clap stomp, clap)
  - Before age 5 children can learn to copy simple patterns with made objects and subsequently learn to extend and create their own pattern.
- ❖ Data Analysis
  - Initially children can sort before they count the number of items in each group or describe them with a label.
  - Typically, young children can only sort a set of objects by one attribute. Normally it is difficult for 4- and 5-year olds to classify a set of objects in more than one way.
  - The normal developmental progression of graphic representation is concrete, to pictorial to symbolic.
  - With a variety of experiences, young children can read the data displayed in pictures and graphs.

### Engaging in Mathematical Activities/Experiences

- Working in a small group, identify and discuss the Components of Math that children can experience when engaging in the following activities/experiences:
- Be prepared to share your information with the large group.



# Activity #1 Dinner Time



## Materials and Preparation:

- ◆ Paper or plastic dishes, cutlery, napkins, and glasses AND placemats
- ◆ Play food or pictures of food such as pizza, cookies, strawberries; juice boxes (at least enough of each to solve the story problems described)
- ◆ One of the following books or another related to meal or snack time: *Feast for 10* by Cathryn Falwell, *10 for Dinner* by Jo Ellen Bogart

## Implementing the Activity for Optimal Learning:

- Read the book. Have the children count aloud as you point to the pictures in the text.
- Display the dishes and such. Tell the children to pretend that they are going to have friends over for dinner. Invite them to discuss what they might serve and who they would invite. Graph their responses.
- Demonstrate and describe how to set a table. Use positional words such as *besides*, *above*, or *on top of*. Pose story problems as shown below and have the children take turns solving them using the materials and play food. Use questions and comments that encourage children to describe how they solve a problem and their reasoning.

*Two friends are coming for dinner. Please set the table for them. Don't forget to set a place for you, too. How many plates, forks...will you need?*

## Closing:

- ❖ Comment on how well the children prepared and served dinner for their friends. Remind them that the dishes and foods will be in the Dramatic Play area to use freely.



What math components can you identify in this activity?

## Activity #2 I Spy



### Materials and Preparation:

- ◆ Binoculars made from two cardboard rolls or a pair of silly glasses

### Implementing the Activity for Optimal Learning:

- Explain how to play "I Spy". Use the binoculars or glasses to look around the room. Then say something like this: *I spy with my little eye, something in the block area on the top shelf, next to the train book. - I spy with my little eye, something in the dramatic play area. It is in the basket, next to the refrigerator. It is like a ball or a sphere, and it is green.*
- Have the children give a thumbs-up sign when they think they have figured out what the object is. Let them whisper the answer to a neighbor. Choose one or more children to reveal their answers. Ask, "How do you know?"
- Continue playing as long as the children are interested. Invite children to take turns being the leader who spies something.
- Note which children are able to use positional words and which children respond to them.

### Closing:

- ❖ Tell children that you will put the binoculars or glasses in one or more interest area so they can play "I spy" with their friends.



What math components can you identify in this activity?

### Math Components

### What Teachers Can Do

<p style="text-align: center;"><b>Number Concepts</b></p> <p>(Understanding numbers, ways of representing numbers, and relationships among numbers)</p>	<ul style="list-style-type: none"> <li>✓ Teach children counting songs, rhymes and chants</li> <li>✓ Count during daily activities – the children present, the cups needed for each child, the paint brushes needed for each container</li> <li>✓ Encourage children to compare relationships between quantities.</li> </ul>
<p><b>Patterns and Relationships</b> (Recognizing, copying and extending patterns; making predictions about patterns; Algebra)</p>	<ul style="list-style-type: none"> <li>✓ Clap hands then pat thighs in a pattern</li> <li>✓ Create “people patterns” with children (sit, stand, sit, stand) and help them to describe the pattern</li> <li>✓ Draw children’s attention to various patterns in the environment</li> <li>✓ Describe patterns you see children creating.</li> </ul>
<p><b>Geometry and Spatial Sense</b> (Recognizing, naming, building, drawing, describing, comparing, and sorting two-and three-dimensional shapes; recognizing and describing spatial relationships)</p>	<ul style="list-style-type: none"> <li>✓ Talk about the geometric shapes as children use blocks or shape blocks</li> <li>✓ Provide empty boxes, tubes and containers for children to use in creating and constructing</li> <li>✓ Take children on a walk looking for shapes in the environment</li> <li>✓ Describe spatial relationships you notice as children play.</li> </ul>
<p style="text-align: center;"><b>Measurement</b></p> <p>(Using nonstandard units to measure and make comparisons)</p>	<ul style="list-style-type: none"> <li>✓ Show children how to use blocks to measure things</li> <li>✓ Use a sand timer or kitchen timer to let children know that there are only five minutes left to clean up</li> <li>✓ Ask open-ended questions during measurement activities.</li> <li>✓ Use words like before, after, next, yesterday, today, tomorrow throughout the day</li> </ul>
<p><b>Data Analysis, Collection, Organization and Representation</b> (Posing questions to investigate, organizing responses, and creating representations of data)</p>	<ul style="list-style-type: none"> <li>✓ Pose a “question of the day”. Show children how to make tally marks under “yes” or “no” on a clipboard</li> <li>✓ Graph collections of objects found in the classroom such as stickers, leaves, rocks, shells, buttons, etc.</li> <li>✓ Have children form a “people graph” in response to your questions about similarities and differences between them.</li> </ul>

**Math in all Classroom Areas**

	<b>Blocks</b>	<b>Dramatic Play</b>	<b>Manipulatives &amp; Games</b>	<b>Art</b>	<b>Sand and Water</b>
<b>Mathematics</b>	<p>Suggest clean-up activities that involve sorting by shape and size.</p> <p>Use language of comparison such as taller, shorter, the same length.</p> <p>Provide materials such as cans, pipes, boxes, maps, measuring tools, floor tiles, carpet pieces, etc.</p>	<p>Add phones, menus, calendars and other items with numbers on them.</p> <p>Facilitate experiences talking about prices, addresses and times of day.</p> <p>Engage in questions such as “I wonder why the rind on this watermelon has a pattern and the other does not. What do you think?”</p>	<p>Provide collections of everyday materials for sorting, classifying and graphing such as, spools, boxes, cardboard tubes, cone-shaped cups, etc.</p> <p>Ask questions to help children to clarify their thinking such as “How do you know which table block is heaviest?”</p> <p>Have children extend patterns with colored cubes, beads, etc.</p>	<p>Use terms of comparison (i.e. the piece of yarn is longer than your arm).</p> <p>Provide empty containers of various shapes and sizes for creating sculptures.</p> <p>Plan activities for children to name, draw or sculpt two- and three-dimensional shapes.</p>	<p>Provide measuring cups, spoons, containers of various sizes.</p> <p>Ask questions such as “How many cups will it take to fill the container?”</p> <p>Include molds for creating patterns within the sand.</p>
	<b>Library</b>	<b>Discovery</b>	<b>Music and Movement</b>	<b>Cooking</b>	<b>Computers</b>
<p>Add number stamps and paper for children to utilize.</p> <p>Include books about math concepts: size, shape, number, comparison, etc.</p> <p>Provide props for dramatizing or retelling stories that address mathematical concepts such as <i>The Three Bears</i>, <i>Caps for Sale</i>, etc.</p>	<p>Have tools on hand for measuring and graphing.</p> <p>Provide boxes for sorting and storing materials by size, color and shape.</p> <p>Add writing instruments, paper and clipboards for children to record their observations and data.</p>	<p>Play percussion games emphasizing patterns: softer/louder.</p> <p>Use language that describes spatial relationships – under, over, around, and through.</p> <p>Provide materials that encourage children to explore different rates of movement – fast or slow.</p>	<p>Use cooking materials such as timer, candy thermometer, measuring cups and spoons, cookie cutters in geometric shapes, etc.</p> <p>Develop graphs with children showing, for example, their favorite kind of fruit.</p> <p>Display picture/word recipes and charts.</p>	<p>Include software that focuses on number concepts, patterning, problem solving, shapes, etc.</p> <p>Use a drawing program to create patterns.</p> <p>Engage in conversations that describe the steps to completing a task on computer – “First you need to, then you, next…”</p>	<p>Provide equipment of varying sizes such as small, medium, large balls, streamers or ribbons.</p> <p>Have children collect nature items on a walk then sort, classify and graph items collected.</p> <p>Develop an obstacle course that invites children to go over, under, through, etc.</p>