TeachingStrategies®

Research Foundation: Mathematics

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Beginning at birth, children use their everyday experiences to construct a variety of fundamental mathematical concepts and strategies. They eagerly explore mathematical concepts and are capable learners of mathematical ideas. In fact, very young children appear to have an intuitive sense of formal mathematics. A 1-year-old asks for more cookies and cries when someone takes one away. Two-year-olds display two fingers to show their age. Three-year-olds use geometric skills as they rotate and stack blocks to form tall towers. As children mature, they need frequent practice with materials in play settings and adult-guided activities that include meaningful discussions and applications to develop the knowledge needed for later, formal learning (Varol & Farran, 2006). This kind of learning enables children to develop the essential process skills of problem-solving, reasoning, communicating, making connections, and representing, which are necessary to learn mathematics content (Copley, 2000; Geist, 2009).

In recent years, as expectations for children and mandates for programs have changed, more researchers have focused their attention on the ability of young children to acquire mathematical skills. Their findings confirm that the way teachers talk with children and the kinds of activities and experiences they plan for them must be intentional if children are to acquire important attitudes, skills, and knowledge about mathematics. Evidence also shows that high-quality early childhood education programs can make a difference (Clements & Sarama, 2009), and early childhood educators, in particular, play a crucial role as one of the primary vehicles through which children learn mathematics (National Research Council, 2009).

To reflect these new research findings, Teaching Strategies has revised *The Creative Curriculum®* *for Preschool*. Unique to the fifth edition is an emphasis on intentionally incorporating and structuring math instruction. From its inception, *The Creative Curriculum* has always taken a comprehensive approach about teaching mathematics in the preschool classroom. The fifth

edition, however, takes mathematical learning to another level with the introduction of special new materials and revisions to the core curriculum. Our updated and new resources help support early childhood educators through every step of the process of teaching math to young children, from explaining and applying research findings in the five volumes that now compose *The Creative Curriculum* to offering specific, focused, small- and large-group instructional guidance illuminated in the new teaching guides and *Intentional Teaching Cards™*.

The revisions to *The Creative Curriculum* involved an extensive literature-based research review of the most significant recent studies on how children learn and develop mathematical skills. The research points out the importance of purposefully and intentionally introducing mathematics to children from a very early age, as their construction of informal mathematical knowledge takes place slowly and through first-hand exploration.

More than 20 years of research suggests that fundamental math skills are the building blocks for future success. Early studies showed that children who demonstrate strong prekindergarten math skills achieve higher math scores in 10th grade (Stevenson & Newman, 1986). Children's block play in preschool also has been linked to future success in junior high and high school, predicting the number of math and honor courses taken, math grades, and math achievement scores (Wolfgang, Stannard, & Jones, 2001). Moreover, early math skills are also a strong predictor of literacy skills (Duncan et al, 2007). An analysis of six longitudinal studies showed that early math skills have the greatest predictive power of later achievement, followed by reading and then attention skills (Duncan, et. al., 2007).

Regardless of social class, culture, or disability, most children develop mathematical skills. However, gaps in some children's informal knowledge make it difficult for them to understand school mathematics (Benigno & Ellis, 2004; Klein & Starkey, 2004). Evidence shows that preschool-age children are excited about learning and enjoy activities that develop their mathematics competencies (Gelman, 1980; Ginsburg et al., 2006; National Research Council, 2001). Thus, this period is critical for maintaining and enhancing a child's motivation to learn, especially for children from disadvantaged backgrounds. Providing enriching early learning experiences can enable them to begin kindergarten on a more level footing with their more advantaged peers (National Research Council, 2009).

Introducing and incorporating math into each day is an essential task for any high-quality early childhood program. The revisions and enhancements to *The Creative Curriculum* provide opportunities for teachers to introduce math all day long, through routines, transitions, and conversations, and offers guidance on including math-related materials in multiple interest areas. *The Creative Curriculum* also shows how to design learning

environments that purposely include mathematics materials in interest areas for child-initiated explorations and carves out time to intentionally provide opportunities for activities with a mathematical focus.

The Components of *The Creative Curriculum for Preschool*

The Creative Curriculum for Preschool is composed of resources that support early childhood educators through every step of the process of teaching math to young children. Our math-related resources include:

- *The Creative Curriculum for Preschool, Volume 4: Mathematics*
- *The Creative Curriculum for Preschool* teaching guides
- *Intentional Teaching Cards* for math
- *Mighty Minutes*™
- *Math Right From the Start: A Parent's Guide to the First Five Years*
- *Building Your Baby's Brain: A Parent's Guide to the First Five Years*

The Creative Curriculum for Preschool, Volumes 1-5

Effective and vibrant early childhood classrooms reflect a fundamental understanding of child development and best early childhood practices. *The Creative Curriculum for Preschool*, fifth edition, combines the current research and knowledge about high-quality early childhood programs into five comprehensive volumes that articulate clearly the "what" and "why" of preschool teaching. The fourth volume in the series, *The Creative Curriculum for Preschool, Volume 4: Mathematics*, is entirely devoted to helping early childhood educators support mathematical learning with young children. It provides an overall blueprint for teaching math in the classroom, containing the latest theories and research on the development of mathematical thinking to guidance for planning meaningful math experiences throughout the day and in all interest areas.

The Creative Curriculum for Preschool Teaching Guides

The six *Creative Curriculum for Preschool* teaching guides are another new resource for teachers, providing daily step-by-step guidance and curriculum plans for the entire year. Five of the teaching guides feature studies—in-depth, hands-on investigations on relevant topics that are designed to captivate children. They provide the context for incorporating math and math-related skills, such as counting and measuring. The first guide, *Beginning the Year*, is not considered a study. It addresses the first six weeks of school, which are devoted to building a strong classroom community,

forging a connection with children's families, and helping children become familiar with the skills needed to conduct an investigation. In the teaching guides, children have the opportunity to explore topics, such as balls, buildings, and trees. Each study offers guidance for teachers for intentionally incorporating math into children's daily explorations. While these comprehensive daily plans make math part of a unified whole, they still allow teachers an opportunity to set discrete math goals in the classroom.

Intentional Teaching Cards for Math

The fifth edition of *The Creative Curriculum for Preschool* contains 79 *Intentional Teaching Cards* that focus specifically on math. The cards—another new addition to the curriculum—describe playful and engaging activities that can be used throughout the day during planned small- and large-group time to teach important math skills to children. Each *Intentional Teaching Card* shows the steps required to implement an activity and lists the objectives it addresses. The *Intentional Teaching Cards* help teachers to ensure that they are also intentionally focusing on specific math skills throughout the day.

Mighty Minutes

The revised curriculum also added *Mighty Minutes*, a collection of songs, chants, rhymes, games, and short activities that help teachers create learning opportunities during "in-between" times. The activities in *Mighty Minutes* intentionally teach mathematical skills, including counting, ordinal numbers, and recognizing and identifying numerals. *Mighty Minutes* activities can be done anywhere and at any time, such as when teachers are preparing to go outside or gathering children for large-group time. They allow teachers to make the most of transitional times through intentional, focused math opportunities.

Math Right From the Start: A Parent's Guide to the First Five Years and *Building Your Baby's Brain: A Parent's Guide to the First Five Years*

Math Right From the Start and *Building Your Baby's Brain* are resources that teachers can share with parents to help support mathematics learning at home. Parents play a significant role in helping children learn and develop in every area, including mathematical vocabulary, concepts, and process skills. These easy-to-read resources show parents simple ways of encouraging brain development and incorporating math into daily routines and experiences at home, beginning from birth. *Math Right From the Start* and *Building Your Baby's Brain* allow teachers to reinforce the essential connection between school and home. They also encourage parents with simple, non-intimidating ways to support their children's brain development and acquisition of mathematical skills.

Application of the Research

The Creative Curriculum for Preschool, Volume 4: Mathematics and other Teaching Strategies resources that focus on mathematics provide early childhood educators with guidance for incorporating math throughout the day and into interest areas, along with purposeful, focused opportunities that nurture the development of mathematical skills in even the youngest of learners. By directly translating into practice the latest research on how children develop and learn mathematical skills, teachers using *The Creative Curriculum for Preschool* can be certain that they are focusing on what matters most for a child's success, in math as well as in other curriculum areas.

What the research says…	*The Teaching Strategies* application…
Number concepts and operations	
To count well, children must learn: 1) the verbal number sequence; 2) one-to-one correspondence; and 3) cardinality (Clements & Sarama, 2009).	Teaching Strategies' curricular materials offer teachers specific activities for practicing counting with children using a variety of instructional strategies. Teaching Strategies' curricular materials incorporate one-to-one correspondence into everyday activities and routines, e.g., children pass out materials so that each child receives one, and teachers touch or point to objects as they count them. Teachers prompt children's thinking about numbers and sets as they ask questions during individual and small-group activities, e.g., "How many are there? How did you find out?" "How did you determine there are more cars than trucks?"

What the research says…	*The Teaching Strategies* application…
Young children must learn to connect quantities with their written number symbols or numerals (Copley, 2000; Payne & Huinker, 1993).	Teaching Strategies' curricular materials show teachers how to connect numeral symbols to classroom activities, e.g., the teacher helps children count the number of letters in their first name and then write their name and corresponding number on the "How Many Letters Are in Our Name?" chart. Guidance is provided on creating a numerically rich environment with a collection of sorting and counting materials with accompanying numeral cards incorporated throughout the classroom. The curriculum shows teachers how to use books that highlight numerical reasoning and the connection between a written numeral and the quantity it represents. Teachers help children create their own numeral books.
Spatial relationships and shapes	
Children who have a strong spatial sense do better in mathematics (Clements, 2004).	Teaching Strategies' curricular materials provide specific teaching strategies to promote children's spatial sense through activities that involve their bodies, such as obstacle courses and acting out stories that use positional and spatial words.

What the research says…	*The Teaching Strategies* application…
Children need to manipulate, draw, compare, describe, sort, and represent shapes in a variety of ways in order to develop their ideas about shapes (Charlesworth, 2005; Clements, 1999).	Teachers encourage children to sketch building plans, make class maps, and look at shapes from different angles. Teaching Strategies' curricular materials focus on helping children learn to describe and manipulate shapes, rather than just memorizing the names of shapes. Interest areas in *The Creative Curriculum* classroom provide opportunities for children to explore and manipulate shapes as they build in the Block and Toys and Games areas. Children also sort shapes using puzzles and shape-sorting manipulatives. Teachers scaffold learning as they interact with children during play.
Comparing and measuring	
Using nonstandard measurement tools, e.g., links, blocks, rods, help children begin to connect number to length. (Clements & Sarama, 2009).	Teaching Strategies' curricular materials describe intentional learning opportunities to help children use nonstandard measurement tools, such as their hands, feet, bodies, and classroom objects to measure objects.
As measurement ideas and skills are developing, children can benefit from exploring and using tools with uniform units, e.g., rulers and centimeter cubes (Clements, 2003; Sarama & Clements, 2006).	The 11 interest areas in *The Creative Curriculum* classroom incorporate objects and materials—measuring cups, rulers, measuring tapes, balance scales—to connect concepts involving measurement, size, and comparison. Teachers are shown how to facilitate children's thinking of measurement as they extend their play in the interest areas, e.g., "How many feet tall is your tower?"; "Let's use the measuring tape to see which car rolled the farthest."

What the research says…	*The Teaching Strategies* application…
Pattern knowledge	
Young children can recognize the relationship between repeating patterns that share the same core unit but that are perceptually different (Sarama & Clements, 2006).	Teaching Strategies' curricular materials provide information on different types of patterns, e.g., shape and size, positional, movement, patterned stories, that children can identify. Teachers will find strategies to promote children's understanding.
Exploring patterns helps children understand some basic algebraic ideas (Copley, 2000).	Guidance is provided to teachers on classroom materials that offer opportunities for children to explore and create patterns, e.g. blocks of various shapes, colors and sizes, natural collections, colored wooden beads, collage materials. Teachers are shown how to point out patterns that naturally occur in the environment, music, and other daily childhood experiences.
Learning experiences that focus on patterns facilitate children's generalizations about number combinations, counting strategies, and problem solving (Copley, 2000).	Teaching Strategies' curricular materials include learning activities that deepen a child's knowledge of numeral concepts and problem solving.

Appendix

Intentional Teaching Card™	Objective Addressed	Dimension Addressed
Dinnertime	Uses number concepts and operations	Counts Quantifies
Counting & Comparing	Uses number concepts and operations Compares and measures	
Seek & Find	Uses classification skills Uses number concepts and operations	Counts
Number Cards	Uses number concepts and operations	Numerals with quantity
Sorting & Classifying	Uses classification skills Uses number concepts and operations	Counts
Tallying	Uses number concepts and operations	Counts
Ice Cubes	Compares and measures	
Baggie Ice Cream	Compares and measures	
Bigger Than, Smaller Than, Equal To	Compares and measures	
Biscuits	Compares and measures	
Graphing	Uses number concepts and operations	Quantifies
Measure & Compare	Compares and measures	
Nursery Rhyme Count	Uses number concepts and operations	Counts Quantifies
Patterns	Demonstrates knowledge of patterns	
Play Dough	Compares and measures	
Show Me Five	Uses number concepts and operations	Counts Quantifies

Intentional Teaching Card™	Objective Addressed	Dimension Addressed
Guessing Jar	Uses number concepts and operations	Counts Quantifies
Bounce & Count	Uses number concepts and operations Compares and measures	Counts Quantifies
Which Has More?	Uses number concepts and operations	Quantifies
I'm Thinking of a Shape	Explores and describes spatial relationships and shapes	Understands shapes
Geoboards	Explores and describes spatial relationships and shapes	Understands shapes
Story Problems	Uses number concepts and operations	Counts Quantifies
Putting Puzzles Together	Explores and describes spatial relationships and shapes	Spatial relationships Shapes
Matzo Balls	Compares and measures	
The Long and Short of It	Compares and measures	
Huff & Puff	Compares and measures	
Peach Cobbler	Compares and measures	
Applesauce	Compares and measures	
Apple Bread	Compares and measures	
Buried Shapes	Explores and describes spatial relationships and shapes	Understands shapes
Lining It Up	Compares and measures	
Which Container Holds More?	Compares and measures	

Intentional Teaching Card™	Objective Addressed	Dimension Addressed
Apple Oat Muffins	Demonstrates knowledge of print and its uses Compares and measures	
Cover Up	Compares and measures	
Action Patterns	Demonstrates knowledge of patterns	
We're Going On an Adventure	Explores and describes spatial relationships and shapes	Spatial relationships
Secret Numbers	Uses number concepts and operations	Quantifies Numerals
Patterns Under Cover	Demonstrates knowledge of patterns	
Let's Go Fishing	Uses number concepts and operations	Counts
Cube Trains	Demonstrates knowledge of patterns	
Making Numerals	Uses number concepts and operations	Numerals
Straw Shapes	Explores and describes spatial relationships and shapes	Understands shapes
Pancakes	Compares and measures	
Musical Water	Compares and measures	
Picture Patterns	Demonstrates knowledge of patterns	
Nesting Dolls	Compares and measures	
My Shadow and I	Explores and describes spatial relationships and shapes	Spatial relationships
Wash Day	Compares and measures	
Balancing Act	Compares and measures	
The Farmer Builds a Fence	Explores and describes spatial relationships and shapes	Understands shapes
Can You Find It?	Explores and describes spatial relationships and shapes	Spatial relationships

Intentional Teaching Card™	Objective Addressed	Dimension Addressed
Modeling Clay	Compares and measures	
Black Bean Corn Salad	Compares and measures	
Gingerbread Cookies	Compares and measures	
Stepping Stones	Explores and describes spatial relationships and shapes	Spatial relationships
Where's the Beanbag?	Explores and describes spatial relationships and shapes	Spatial relationships
Yogurt Fruit Dip	Compares and measures	
Missing Lids	Explores and describes spatial relationships and shapes Compares and measures	Spatial relationships
More or Fewer Towers	Uses number concepts and operations	Counts Quantifies
Morning, Noon, and Night	Compares and measures	
Shake, Rattle, and Roll	Uses number concepts and operations Explores and describes spatial relationships and shapes	Counts Quantifies Shapes
How Big Around?	Compares and measures	
Fishing Trip	Uses number concepts and operations	Counts Quantifies
Five-Layer Dip	Compares and measures	
Cornbread	Compares and measures	

Intentional Teaching Card™	Objective Addressed	Dimension Addressed
Oobleck	Uses number concepts and operations	Counts Numerals
Fruit Smoothies	Uses number concepts and operations	Counts
Trail Mix	Uses number concepts and operations	Counts
Cream Cheese & Strawberry Snacks	Compares and measures	Counts Numerals
Egg Salad	Compares and measures	
Flat Bread	Compares and measures	
Macaroni & Cheese	Compares and measures	
Oatmeal Raisin Cookies	Compares and measures	
Vegetable Stir Fry	Compares and measures	
Sugar Cookies	Compares and measures	
Orange Banana Yogurt Pops	Compares and measures	
Board Games	Uses number concepts and operations	Counts Quantifies
Math Collage	Uses number concepts and operations	Numerals
Ping Pong Pick Up	Uses number concepts and operations	Numerals

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