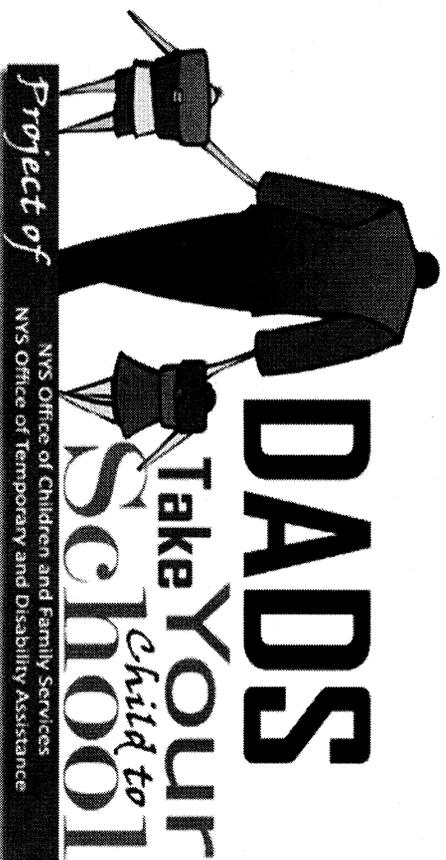


SAVE THE DATE:

Tuesday, September 17, 2013

DADS Take Your Child to School Day



For more information, get the DTYCTS Organizing Guide
at the ACS website at www.nyc.gov/acs

Reading with Dad Book List

For younger children

Baby Dance (1999) by Ann Taylor

A board book in which an African-American father croons to his baby daughter and dances while holding her.

Because Your Daddy Loves You (2005) by Andrew Clements

When things go wrong during a day at the beach, a father could do a lot of things but always picks the loving one.

Daddies Are For Catching Fireflies (1999) by Harriet Ziefert

A lift-the-flap book that shows all the special things daddies can do.

Daddy is a Doodlebug (2000) by Bruce Degen

Written with inventive rhyme, a father bug and his child savor the special joys of companionship.

Daddy Makes the Best Spaghetti (1986) by Anna Grossnickle Hines

A board book featuring a family with a stay-at-home dad.

The Daddy Mountain (2004) by Jules Feiffer

A little girl's step-by-step account of climbing all the way up on top of her daddy's head.

Dad's Dinosaur Day (1993) by Diane Dawson Heard

A dad's behavior changes when he becomes a dinosaur for a day.

Kevin and His Dad (1999) by Irene Smalls

With Mom away on a Saturday, a father and son spend the whole day together doing household chores and then some fun activities.

Let's Play Rough (2000) by Lynne Jonell

A young boy wants to play rough - but not too rough - with his father.

Lots of Dads (1997) by Shelley Rotner & Sheila M. Kelly

Bright, joyful photos and a simple text show how dads are different and special.

My Dad (1991) by Debbie Bailey

A board book with photos of a variety of dads and children in everyday settings.

My Dad (2000) by Anthony Browne

A child exaggerates the many wonderful things about his dad.

My Daddy is a Giant (2004) by Carl Norac

A young child loves and admires his father – a true giant among men.

Night Shift Daddy (2000) by Eileen Spinelli

A father who works the night shift has a special bond with his daughter.

Octopus Hug (1993) by Laurence Pringle

A burly father leads his children into some active games and imaginative play.

On a Wintry Morning (2000) by Dori Chaconas

A graceful poem of a father and baby bundling up for an early morning outing.

Papa, Do You Love Me? (2005) by Barbara M. Joesse

When a Masai father in Africa answers his son's questions, the boy learns that his father's love for him is unconditional.

Pete's A Pizza (1998) by William Steig

A dad brightens up a rainy day with a fun game of making his son into a pizza.

Piggy and Dad Go Fishing (2005) by David Martin

When his dad takes Piggy fishing for the first time and Piggy ends up feeling sorry for the worms and the fish, they decide to make some changes.

Rainy Day (2000) by Emma Haughton

Shortly after his parents have separated, a son spends a rainy day with his father.

* **A Special Kind of Love** (1995) by Stephen Michael King

A father builds wonderful things out of boxes for his son as his special way of saying "I love you."

Two Homes (2001) by Claire Masurel

A young boy enjoys the homes of both his parents who live apart but love him very much.

The Very Best Daddy of All (2004) by Marion Dane Bauer (Minnesota Author)

Pictures and rhyming text show how animal, bird, and human fathers take care of their children.

Vroomaloom Zoom (2000) by John Coy (Minnesota Author)

A father takes his daughter on an imaginary car ride, lulling her to sleep with various sounds.

What Dads Can't Do (2000) by Douglas Wood (Minnesota Author)

A humorous account of how dads show love by explaining all the things they cannot do.

For older children

Animal Dads (1997) by Sneed B. Collard III

Within the natural world, animal fathers have specific roles.

Carlos and the Cornfield/Carlos y la milpa de maiz (1995) by Jan Romero Stevens

In this English/Spanish bilingual story, a boy learns the meaning of his father's statement, "You reap what you sow."

Dad and Me in the Morning (1994) by Patricia Lakin

A young deaf boy spends a glorious morning sharing the beauty of a sunrise with his father.

Dad, Jackie, and Me (2005) by Myron Uhlberg

A boy learns the connection between his deaf father and the first black baseball player in the Major Leagues.

* **Daddy, Could I Have an Elephant?** (1996) by Jake Wolf

A father and son discuss the boy's exotic ideas about getting a pet.

Daddy Played Music for the Cows (1995) by Maryann Weidt (Minnesota Author)

A daughter's memories of her father and growing up on a farm.

Daddy Poems (2000) selected by John Micklos, Jr.

A collection of short poems honoring fatherhood.

Daddy's Roommate (1990) by Michael Willhoite

A child with divorced parents lives with his gay father and his partner.

Faraway Home (2000) by Jane Kurtz

A little girl in America worries as her father prepares for a trip to visit his ill mother in Ethiopia.

Fly Away Home (1991) by Eve Bunting

A father and son are homeless and living at the airport.

How Many Stars in the Sky? (1991) by Lenny Hort

When a father and son can't sleep, they take a long drive to the country to count the stars.

Just the Two of Us (2001) by Will Smith

A popular song adds to the story of a father's love as his child grows from a boy into a man.

Lewis & Papa (1998) by Barbara Joosse

While accompanying his father on the wagon train along the Santa Fe Trail, a young boy discovers what it means to be a man.



Loon Summer (2001) by Barbara Santucci

A girl and her father spend their first summer at the lake without the girl's mother.

My Father's Boat (1998) by Sherry Garland

A Vietnamese immigrant tells his son how he learned to fish from his father.

Night Driving (1996) by John Coy (Minnesota Author)

A father and son drive into the night and watch for night animals, swap baseball stories, and keep a lookout for eighteen wheelers.

Owl Moon (1987) by Jane Yolen

On a winter's night under a full moon, a father and daughter trek into the woods to go owling.

Papa's Latkes (2004) by Michelle Edwards (Minnesota Author)

A father and his two daughters try to make latkes and celebrate on the first Hanukkah after the girls' mother died.

* **Papa's Stories** (1994) by Dolores Johnson

A little girl enjoys her father reading stories to her, but then discovers he's telling stories because he can't read.

Sammy Wakes His Dad (2002) by Chip Emmons

A father, who uses a wheelchair, is reluctant to go fishing with his son until his son's love finally moves him to action.

The Summer My Father Was Ten (1998) by Pat Brisson

A father tells his son the story of how he damaged a neighbor's tomato garden when he was a boy and what he did to make amends.

Tell Me One Thing, Dad (2004) by Tom Pow

A little girl and her dad have a going-to-bed routine that shows how much they love each other.

Tell Me What We Did Today (2003) by Rick Kupchella (Minnesota Author)

A father and daughter share special time reviewing the real and made-up things that happened during their day.

Two Old Potatoes and Me (2003) by John Coy (Minnesota Author)

After a girl finds two old potatoes at her father's house, they plant and tend them to see if they will grow new potatoes.

Visiting Day (2002) by Jacqueline Woodson

A young girl and her grandmother visit the girl's father in prison.



The Wall (1990) by Eve Bunting

A little boy and his father visit the Vietnam Veterans Memorial in Washington, DC to find the name of the boy's grandfather.

When Dad's at Sea (2004) by Mindy L. Pelton

A soldier's daughter worries about her dad on his mission far away from home.

About this list

The Minnesota Humanities Center's Reading with Dad book list includes quality children's picture books featuring fathers. The list was originally developed in 2001 by the Minnesota Humanities Center, involving a group of local children's literature specialists, and has been revised several times, most recently in January 2007. Most of these books are readily available through bookstores and libraries; those marked with an asterisk (*) may be difficult to find in bookstores but can often be located through local libraries.

Together Time Activities for Families of Prekindergarten Children

Infusing the Common Core Learning Standards into Our Daily Routines

You are your child's first and most important teacher and it is important for you to continue to spend quality time with your child every day.

New York State recently adopted a new set of learning standards known as the Common Core Learning Standards (CCLS). The CCLS focus on basic skills as well as problem solving and higher order thinking skills. The standards clearly lay out what students should know and be able to do in every grade to ensure they are on a path toward being ready for college and careers.

Standards alone cannot raise the level of student learning. Their full power can only be realized when all learning environments—including home and school—are connected. The Office of Early Childhood Education has compiled some “together time” literacy and math activities that you and your child can engage in at home and while on the go. These activities can support your child's physical, social, emotional, and cognitive development as well as prepare them to think creatively and solve problems. These skills are needed as a foundation for all students to succeed in college, careers, and in life.

More information about the Common Core Learning Standards may be found at:

<http://schools.nyc.gov/Academics/CommonCoreLibrary/FamilyResources/default.htm>

<p style="text-align: center;">At Home Literacy Activities</p>	<p style="text-align: center;">Pre-K Common Core Learning Standards for Literacy</p>
<p>Go to the library and find books with few or no words. Point to the illustrations and encourage your child to interpret what is happening in the story. Help make real life connections by providing examples, such as, "This picture reminds me of the time you lost your teddy bear and were so sad." Encourage your child to talk about what the story reminds them of.</p>	<p>Reading Standards for Literature <i>Responding to Literature</i></p> <ol style="list-style-type: none"> 1. With prompting and support, make connections between self, text, and the world around them (text, media, social interaction).
<p>After reading with your child, talk about what each of you liked or disliked about the book and why. If you have more than one child, read a picture book together and take turns sharing your thoughts at the end of the book. To spark conversation, ask questions or pose a statement for them to respond to, such as, "My favorite part of the book was..."</p>	<p>Speaking and Listening Standards <i>Comprehension and Collaboration</i></p> <ol style="list-style-type: none"> 1. With guidance and support, participate in collaborative conversations with diverse partners about <i>pre-kindergarten topics and texts</i> with peers and adults in small and large groups. <ol style="list-style-type: none"> a) Engage in agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
<p>Look at family photographs together and explore how people change over time. Encourage your child to ask questions about the people in the pictures and provide stories in response. For example, "Here is a picture of Uncle Greg when he was 8 years old. He is my little brother which is why I am taller than him in this photograph. But, you're right...he is taller than me now that we're adults."</p>	<p>Speaking and Listening Standards <i>Comprehension and Collaboration</i></p> <ol style="list-style-type: none"> 2. With guidance and support, confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
<p>Play word games with your child as you're walking down the street, riding the subway, or waiting in line at the store. Ask your child to name the opposite word of everyday actions, such as the opposite of <i>on</i> the table is <i>off</i> the table. Also help your child describe opposite emotions, such as the opposite of feeling <i>tired</i> is <i>energized</i>.</p>	<p>Language Standards <i>Vocabulary Acquisition and Use</i></p> <ol style="list-style-type: none"> 5. With guidance and support, explore word relationships and nuances in word meanings. <ol style="list-style-type: none"> b) Demonstrate understanding of frequently occurring verbs and adjectives by relating them to their opposites (e.g., up, down, stop, go, in, out).

<p style="text-align: center;">At Home Literacy Activities</p>	<p style="text-align: center;">Pre-K Common Core Learning Standards for Literacy</p>
<p>Help your child to write 'thank you' notes for birthday and holiday gifts. Prompt him to draw a picture and tell what was special about that day. Write exactly what your child says in response, and encourage him to try to write or guess letters in a word on the note card.</p>	<p>Language Standards <i>Conventions of Standard English</i></p> <p>2. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p> <p>b) Attempt to write a letter or letters to represent a word.</p> <p>Writing Standards <i>Text Types and Purposes</i></p> <p>3. With prompting and support, use a combination of drawing, dictating, or writing to narrate a single event and provide a reaction to what happened.</p>
<p>Ask your child to help you make a list of what to buy at the grocery store. Encourage her to draw pictures and provide details about the items, and write exactly what she says next to the pictures. Have your child go to the grocery store with you and help find the items on the list.</p>	<p>Writing Standards <i>Text Types and Purposes</i></p> <p>2. With prompting and support, use a combination of drawing, dictating, or writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.</p>
<p>Find out what your child's classroom theme is and create a project at home that connects to that theme. For example, if the class is reading books by author Eric Carle all month, create a paper bag puppet of the "hungry little caterpillar" character and re-enact the story at home.</p>	<p>Writing Standards <i>Responding to Literature</i></p> <p>1. Create and present a poem, dramatization, art work, or personal response to a particular author or theme studied in class, with prompting and support as needed.</p>

At Home Math Activities	Pre-K Common Core Learning Standards for Math
<p>While at home or walking to the park, make up a number of silly steps that can be acted out by your child. For example, take two backwards steps to the door and walk five zigzag steps down the sidewalk. With your child, count out the number of steps it takes to get from one place to the next starting with 1 and increasing to 20.</p>	<p>Counting and Cardinality <i>Know number names and the count sequence</i></p> <ol style="list-style-type: none"> Count to 20 <p><i>Count to tell the number of objects</i></p> <ol style="list-style-type: none"> Understand the relationship between numbers and quantities to 10; connect counting to cardinality.
<p>As your child gets dressed in the morning, remember to name the steps aloud stating what comes first, second, third, and last. Take photographs of your child's daily routines and play a game sequencing the images from first to last. The photographs can also be used to help your child choose what to do independently, and what to do with your help.</p>	<p>Counting and Cardinality <i>Compare numbers</i></p> <ol style="list-style-type: none"> Identify "first" and "last" related to order or position.
<p>Encourage your child to help you set the table for mealtime and figure out how many forks, spoons and cups are needed for each family member. Ask questions that encourage mathematical problem solving, such as, "We have five people eating dinner. How many napkins will we need? What happens if one napkin gets dirty too quickly?"</p>	<p>Counting and Cardinality <i>Compare numbers</i></p> <ol style="list-style-type: none"> Identify whether the number of objects in one group is more, less, greater than, fewer, and /or equal to the number of objects in another group, e.g., by using matching and counting strategies.
<p>Go on a pattern search in your home finding shapes, colors, and designs that repeat over and over again. With your support your child may start to recognize a pattern of lines on a shirt or a pattern of squares in the bathroom tiles.</p> <p>You may also listen for patterns. Listen for the repetitive sound of a drum beat and try repeating the rhythm while clapping your hands.</p>	<p>Operations & Algebraic Thinking <i>Understand simple patterns.</i></p> <ol style="list-style-type: none"> Duplicate and extend (e.g., what comes next?) simple patterns using concrete objects.

<p style="text-align: center;">At Home Math Activities</p>	<p style="text-align: center;">Pre-K Common Core Learning Standards for Math</p>
<p>At the end of each month, measure your child's height and growth and record on chart paper. Pose some mathematical problems that you and your child can solve together. For example, "Let's find out how much you grew since September. Let's measure the difference with a pencil to find out how many pencils tall you grew!"</p>	<p>Operations and Algebraic Thinking <i>Understand addition as adding to, and understand subtraction as taking from.</i></p> <ol style="list-style-type: none"> 1. Demonstrate an understanding of addition and subtraction by using objects, fingers, and responding to practical situations (e.g., if we have 3 apples and add 2 more, how many apples do we have all together?). <p>Measurement and Data <i>Describe and compare measurable attributes</i></p> <ol style="list-style-type: none"> 1. Identify measurable attributes of objects, such as length, and weight. Describe them using correct vocabulary (e.g., small, big, short, tall, empty, full, heavy, and light).
<p>Ask your child to help you sort clean laundry. Prompt your child to find all of the matching socks and make pairs, or sequence the pants in a row from shortest to longest. Make separate piles for each family member, estimate how many articles of clothing are in each, and count the number of articles to find out the correct answer.</p>	<p>Measurement and Data <i>Describe and compare measurable attributes</i></p> <ol style="list-style-type: none"> 1. Identify measurable attributes of objects, such as length, and weight. Describe them using correct vocabulary (e.g., small, big, short, tall, empty, full, heavy, and light). <p><i>Sort objects and count the number of objects in each category</i></p> <ol style="list-style-type: none"> 2. Sort objects into categories; count the numbers of objects in each category (limit category counts to be less than or equal to 10).
<p>Encourage your child to help you put away the groceries by sorting the items by type, color, size or shape. Compare how many fruits and vegetables you have, or edibles to non-edibles. Ask questions that encourage thinking about attributes, such as, "Can you find 5 grocery items with corners like this box of cereal? Let's place all the items with corners here."</p>	<p>Measurement and Data <i>Sort objects and count the number of objects in each category</i></p> <ol style="list-style-type: none"> 2. Sort objects into categories; count the numbers of objects in each category (limit category counts to be less than or equal to 10). <p>Geometry <i>Analyze, compare, and sort objects</i></p> <ol style="list-style-type: none"> 1. Analyze, compare, and sort two- and three-dimensional shapes and objects in different sizes, using informal language to describe their similarities, differences, and other attributes (e.g., color, size, and shape).

At Home Math Activities	Pre-K Common Core Learning Standards for Math
<p>On a neighborhood stroll, stop and observe the two- and three-dimensional shapes of street signs and buildings. Ask your child to name the different parts of a building, such as the roof, door, and columns. At home, re-create a three-dimensional structure that you observed out of blocks, or by re-using materials such as boxes and toilet paper tubes.</p>	<p>Geometry <i>Analyze, compare, and sort objects</i></p> <ol style="list-style-type: none"> 1. Analyze, compare, and sort two and three dimensional shapes and objects in different sizes, using informal language to describe their similarities, differences, and other attributes (e.g. color, size, and shape). 2. Create and build shapes from components (e.g., sticks and clay balls).
<p>With your child, identify common shapes that are found in everyday food and objects. Maybe you eat triangle sandwiches, cheese cubes, or oval beans for lunch! Help your child identify and name the positions of the objects, such as the placement on a shelf or on a plate. For example, "The cheese is on top of the circle crackers. Can you place the cheese squares under the crackers?"</p>	<p>Geometry <i>Identify and describe shapes (square, circles, triangles, rectangles)</i></p> <ol style="list-style-type: none"> 1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as top, bottom, up, down, in front of, behind, over, under, and next to. 2. Correctly name shapes regardless of size.
<p>Look through children's magazines for pictures of animals and cut these images out. Ask your child to name the animals and categorize them by familiar traits. One trait may be animals with fur and one may be animals with wings. Be silly and create new categories! For example, try grouping animals with two ears and animals with wings together and discuss their differences and similarities.</p>	<p>Geometry <i>Analyze, compare, and sort objects</i></p> <ol style="list-style-type: none"> 1. Analyze, compare, and sort two and three dimensional shapes and objects in different sizes, using informal language to describe their similarities, differences, and other attributes (e.g. color, size, shape).



REVIEW

Early Childhood Mathematics Intervention

Douglas H. Clements* and Julie Sarama*

Preschool and primary grade children have the capacity to learn substantial mathematics, but many children lack opportunities to do so. Too many children not only start behind their more advantaged peers, but also begin a negative trajectory in mathematics. Interventions designed to facilitate their mathematical learning during ages 3 to 5 years have a strong positive effect on these children's lives for many years thereafter.

Very young children have the potential to learn mathematics that is complex and sophisticated (1, 2). Unfortunately, this potential is left unrealized for many children throughout the world (1–5). Fortunately, research-based early childhood mathematics interventions exist that increase these children's mathematical knowledge (6). There is much to gain, and little to lose, by engaging young children in mathematical experiences.

Mathematical thinking is cognitively foundational. Preschool children's knowledge of mathematics predicts their later school success into elementary (7) and even high school (1, 6). Further, it predicts later reading achievement even better than early reading skills (7), and the study of mathematics in high school predicts college science achievement across subjects (8). The quantitative, spatial, and logical reasoning competencies of mathematics may form a cognitive foundation for thinking and learning across subjects. Given the importance of mathematics to academic success and to a nation's economic success (6, 9), all children need a robust knowledge of mathematics in their earliest years.

Not all children have adequate opportunities to develop this cognitive foundation. For example, some 6-year-olds have not acquired mathematical knowledge that other children acquire at 3 years of age (5). Although both groups of children may have informal experiences with quantitative situations, those from low-resource communities may have fewer opportunities to mathematize this tacit knowledge; that is, to reflect on and represent the situations [with cognitive tools, from verbal language to finger patterns; compare (9)]. For example, children from low- and middle-income families perform similarly on mathematics problems involving physical objects. When shown three counters that are then covered, then shown one more added to those under the cover, children from both groups perform equally

well in making a matching set of four. However, children from middle-income groups perform significantly better in solving similar problems presented verbally and without physical objects (10). Children from low-income families also are less able to explain mathematical ideas and processes (10). Such representations and explanations constitute valued goals in mathematics education (6), are essential components of mathematical knowledge (e.g., preverbal number knowledge is shared by other species and is not mathematical until it is represented) (1, 2), and play an influential role in promoting future

mathematics learning (11). Therefore, children must learn to mathematize their informal experiences by abstracting, representing, and elaborating them mathematically. If they do not, they miss the opportunity to learn the language of mathematics in all its multifaceted forms.

High-quality education can help children mathematize (4). Without such education beginning in preschool, too many children, especially from low-resource communities, follow a path of failure in mathematics (1). However, present-day early childhood classrooms in many countries do not provide high-quality mathematics experiences, with many children learning little over the course of an entire academic year (1, 5, 12–14) and some regressing on certain skills (15).

Early childhood teachers often believe they are “doing mathematics” when they provide puzzles, blocks, and songs. Even when they teach mathematics, that content is usually not the main focus, but is embedded in a fine-motor or reading activity. Unfortunately, evidence suggests that such an approach is ineffective, owing to a lack of explicit attention to mathematical concepts and procedures along with a lack of intentionality to engage in mathematical practices (1, 16).

To improve mathematics learning for all young children, and especially to address inequities faced by children from low-resource communities,

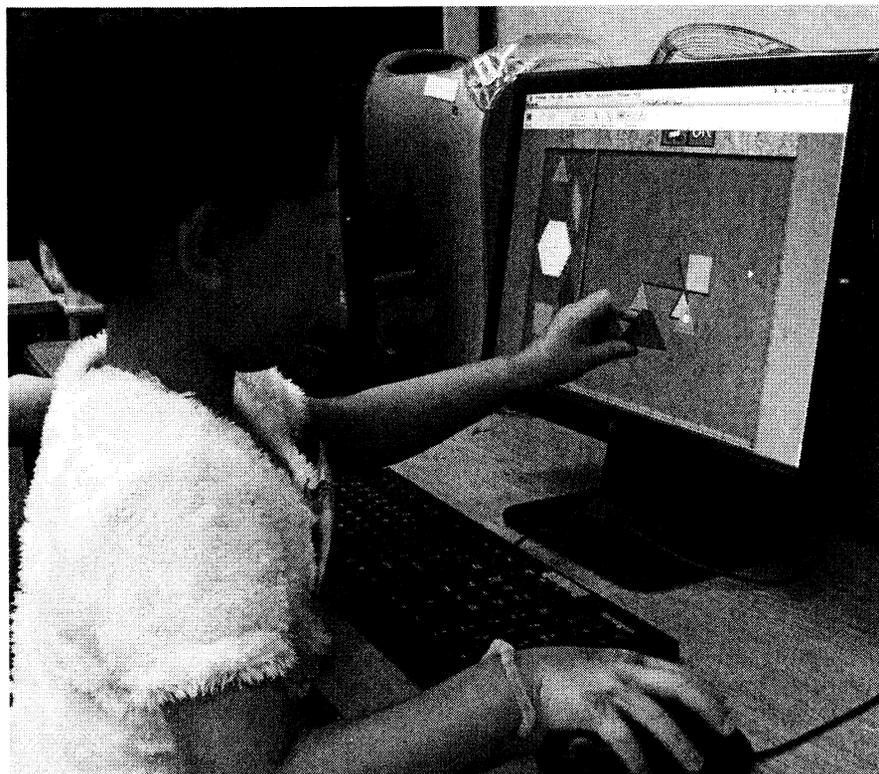


Fig. 1. Learning to compose shapes using physical objects and computer manipulatives. This girl is operating at the initial level of thinking. The *Building Blocks* software moves forward or backward along the learning trajectory.

Graduate School of Education, University at Buffalo, State University of New York, Buffalo, NY 14260, USA.

*To whom correspondence should be addressed. E-mail: clements@buffalo.edu; jsarama@buffalo.edu

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developers have designed research-based interventions. These positively affect children's competencies in mathematics and beyond.

Scientific Interventions

Several research-based interventions for 3- to 5-year-old children have been scientifically evaluated with positive effects, including *Rightstart* (4), *Pre-K Mathematics* (17, 18), and *Building Blocks* (12), while others show promise but await rigorous evaluation, such as *Big Math for Little Kids* (19). Two of these interventions share several characteristics, allowing the abstraction of general principles guiding effective interventions for preschool children. We first describe the two interventions and their initial empirical support, then describe their shared characteristics.

The authors of the *Rightstart* program theorized that children separately build initial counting competencies, intuitive ideas of quantity comparison, and initial notions of change (e.g., a group gets bigger when items are added). The integration of these separate ideas forms a central conceptual structure for number. On this basis, activities were designed to help children build each separate competence and then integrate them. For example, the program used games and experiences with different models of number (e.g., groups of objects, pictures, thermometers, or dials; the program was renamed *Number Worlds* to emphasize this characteristic) to develop children's central conceptual structure for number.

This program improved young children's knowledge of number, which supported their learning of more complex mathematics through first grade (4). In a 3-year longitudinal study, children from low-resource communities who experienced the program from kindergarten surpassed both a second low-resource group and a mixed-resource group who showed a higher initial level of performance and attended a magnet school with an enriched mathematics curriculum (20, 21). Although there are caveats, given that the *Number Worlds* teachers received substantial help from the program developers and expert teachers, and the number of students was small (21), these results suggest that scientifically based interventions have the potential to close achievement gaps in mathematics.

The second program, *Building Blocks*, was developed and evaluated according to a comprehensive research framework (22). *Building Blocks'* basic approach is finding the mathematics in, and

developing mathematics from, children's activity. The curriculum was designed to help children extend and mathematize their everyday activities, from building blocks to art and stories to puzzles and games (Fig. 1). Educational goals included developing competence in the two domains consistently identified as foundational: (i) number concepts (including counting and the earlier developing competence of subitizing, or recognizing the numerosity of a group quickly) and arithmetical operations, and (ii) spatial and geometric concepts and processes. Each of these domains was structured along research-based learning tra-



Fig. 2. Identifying shapes in a "feely box" before seeing them develops children's ability to identify shapes by their attributes.

jectories (1, 2), a construct to which we will return. A series of studies documents that *Building Blocks* increases the mathematics knowledge of preschoolers from low-resource communities more than "business-as-usual" curricula [e.g., (12)].

The *Number Worlds* and *Building Blocks* programs share several characteristics. Both sets of authors used research to include a comprehensive set of cognitive concepts and processes (*Number Worlds* focused only on the domain of numbers). Both programs use a mix of instructional methods, including explicit instruction (but not overly didactic, which can have negative outcomes for the youngest children) (23). Both are based on developmentally sequenced activities, and both help teachers learn about, assess, and intervene on the basis of those sequences. This characteristic is central to the *Building Blocks* cur-

riculum, with every aspect (e.g., text, software, and professional development) connected to an explicit core of learning trajectories for each mathematical topic. Similar use of learning trajectories (often using different terms, but sharing the core construct) in designing curricula and professional development may be responsible for the success of many early mathematics projects (3, 12, 24, 25).

Learning trajectories: Directions for successful learning and teaching. On the basis of Simon's seminal work (26), we define a learning trajectory as composed of three components: a goal, a developmental progression, and instructional activities (2). To attain a certain mathematical competence in a given topic (the goal), children learn each successive level of thinking (the developmental progression), aided by tasks (instructional activities) designed to build the mental actions-on-objects that enable thinking at each higher level. For example, the goal might be for young children to become competent counters, counting being the first and most basic mathematical algorithm. The developmental progression describes a typical path children follow in developing an understanding of and skill in counting. At one level of thinking, they acquire the cardinality concept by connecting the last number of the counting processes to the output of their subitizing (which by definition is cardinal). This catalyzes a count-to-cardinal transition, producing a cardinal value ("fourness" connected to subitized images) and verbal label ("four") that are associated with the set counted (1). (For more detail on this learning trajectory, see the SOM text and fig. S1.)

Such learning trajectories provide not only multiple educational advantages but also a core around which varied educational activities can be structured. The levels of thinking of their developmental progressions integrate the essential aspects of concepts, skills, and problem solving (6, 27) and provide benchmarks for assessments (1, 2, 5). Research-based instructional activities provide guidelines for writing curriculum, teaching, and professional development. Such guidance is especially important for professional development because early childhood teachers' knowledge of mathematics, young children's mathematical development, and instruction are positively correlated to their children's achievement (1, 2, 28). Without such knowledge, teachers of young children often offer tasks that are either too easy or too hard for children, and do not



INVESTING EARLY IN EDUCATION

recognize the mismatch (29). Thus, teachers need integrated knowledge of all three components of learning trajectories: the mathematical content (goal), the developmental progressions of children's thinking and learning, and instructional tasks and teaching strategies that help children move along those progressions (1). In this way, learning trajectories can facilitate developmentally appropriate teaching and learning for all children (1). Other early mathematics projects that demonstrate learning gains share many of these conceptual foundations (2, 3, 30).

Although promising, initial studies of *Number Worlds* and *Building Blocks* used the individual child as the unit of analysis, despite their assignment to treatments by classroom, which can inflate findings. Therefore, we conducted a larger study involving cluster randomized assignment of 36 classrooms (24). The *Building Blocks* curriculum increased the quantity and quality of the mathematics environment and teaching, and substantially increased scores on a mathematics achievement test, with the *Building Blocks* group significantly outperforming both a "business-as-usual" control group and a group using the *Pre-K Mathematics* curriculum, which was not based on the learning trajectories construct.

A subsequent study evaluated whether these results could be scaled up; that is, could an intervention framework be designed that maintained the integrity of practices of the intervention in increasingly wider contexts characterized by increases in both number (of children, teachers, etc.) and complexity (6)? Based on a synthesis of literature, we created the TRIAD (Technology-enhanced, Research-based, Instruction, Assessment, and Professional Development) framework, whose guidelines include collaboration among key groups (e.g., administrators, teachers, families); extensive, multifaceted professional development; and strategies to maintain the integrity of the research-based *Building Blocks* curriculum. TRIAD emphasizes both teaching for understanding and following learning trajectories (31). Over the course of 2 years, teachers participated in 12 full days of professional development with presentations, discussions, and role-playing addressing all three components of the learning trajectories, as well as use of the Web application *Building Blocks Learning Trajectories (BBLT)*, which presented and linked the components. *BBLT* provides scalable access to the learning trajectories by means of descriptions, videos, commentaries, and connections between children's levels of thinking and instruction (25, 31) (see also UBTRIAD.org). Teachers then implemented the curriculum with mentoring based on an observational fidelity instrument.

The experiment supported the efficacy of the TRIAD model, with strong positive effects on children's achievement (25). Most groups (e.g., girls and boys, different compositions of socioeconomic status) demonstrated equal learning

gains. However, African American children in the control group showed smaller gains than their peers in the same group. Inversely, within the TRIAD group African American children showed larger gains than their peers (narrowing, but not closing the initial achievement gap). The TRIAD/*Building Blocks* intervention may be particularly effective in ameliorating the negative effects of some educators' low expectations for African American children's learning of mathematics (6) through providing learning trajectories that help teachers see what children can do and how they can be helped to progress to higher levels of mathematical thinking.

Several effective primary grades interventions also use some version of the learning trajectories construct (3, 4, 16, 32, 33), for example, emphasizing the use of research-based progressions in formative assessment (6). They explicitly attend to conceptual understanding by addressing, discussing, and developing connections among concepts, facts, procedures, and processes (34) and do not drill basic facts until conceptual foundations and meaningful strategies are developed (35). They challenge students to solve demanding mathematical problems, going beyond learning facts, helping them to learn to think mathematically (27).

Conclusion

Mathematics is cognitively foundational, with early mathematics competence a strong predictor of later school success. Young children have the potential to learn mathematics that is both deep and broad. For many, especially those from low-resource communities, this potential has been unrealized. Structured, research-based mathematics interventions have shown to be effective in helping all children learn mathematics (Fig. 2). Evidence supports interventions that provide foundational and mathematical experiences in number, space, geometry, measurement, and the processes of mathematical thinking.

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Supporting Online Material

www.sciencemag.org/cgi/content/full/333/6045/968/DC1

SOM Text

Figs. S1 and S2

References

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A Parent's Guide to Understanding The New York State Prekindergarten Foundation for the Common Core

Helping Your Child Succeed in School and Prepare for College and Career



This guide will help you better understand what children learn in pre-k so that you can more effectively support your child's learning at home.

What is the Prekindergarten Foundation for the Common Core?

Pre-kindergarten is a time of growth and exploration for you and your child. Your child's development throughout the year can happen at different stages and times, but there are some milestones based on research, theory, and practice that we expect children will achieve by the end of the prekindergarten year. These milestones are captured in the NYS Prekindergarten Foundation for the Common Core.

The New York State Pre-kindergarten Foundation for the Common Core is organized into five domains of development, each of which is defined below.

5 Domains of Development	
Approaches to Learning	<ul style="list-style-type: none"> How children become involved in learning and acquiring knowledge
Physical Development and Health	<ul style="list-style-type: none"> Children's physical health and ability to engage in daily activities
Social and Emotional Development	<ul style="list-style-type: none"> The emotional competence and ability to form positive relationships that give meaning to children's experiences in the home, school and larger community
Communication, Language and Literacy	<ul style="list-style-type: none"> Children's understanding, creating, and communicating meaning
Cognition and Knowledge of the World	<ul style="list-style-type: none"> What children need to know and understand about their world and how they apply what they know.

You will find suggestions on the next page to support your child's learning at home and on the go in each domain. Working together, we can give your child the best start for school.

Definitions from: *New York State Prekindergarten Foundation for the Common Core*
 (http://www.p12.nysed.gov/ciai/common_core_standards/pdfdocs/nyslsprek.pdf)

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Domain 1: Approaches to Learning

How children become involved in learning and acquiring knowledge

Supporting at home and on the go activities.

- Take your child to places that encourage active exploration, such as children's museums. Allow plenty of time for exploring and solving problems.
- Talk to your child throughout the day about her experiences and allow her to share her reflections with you. Help your child make connections between experiences.

Domain 2: Physical Development and Health

Children's physical health and ability to engage in daily activities

Supporting at home and on the go activities:

- Help your child strengthen large muscles by walking up stairs, climbing a ladder at the playground, running, jumping and dancing.
- Help your child strengthen small muscles by squeezing and twisting play dough, cutting with child safety scissors, coloring and painting.

Domain 3: Social and Emotional Development

The emotional competence and ability to form positive relationships that give meaning to children's experiences in the home, school and larger community

Supporting at home and on the go activities:

- Set up daily routines for waking, cleaning, eating, playing, reading, working, napping and bed time.
- Teach your child coping skills and strategies to calm down by breathing, thinking, singing, and relaxing or walking away.

Domain 4: Communication, Language, and Literacy

Children's understanding, creating and communicating meaning

Supporting at home and on the go activities:

Communication and Language

- Talk to your child about the things you do when you are cooking, driving, shopping or doing chores.
- Help your child learn new vocabulary by identifying new words they see and what they mean.

Literacy

- Read different types of books to your child and ask him to tell you what happens next or how he might react in the same situation.
- Keep different writing tools like crayons, pencils, markers, chalk and writing pads, paper or tablets around and allow your child to write, draw, or dictate stories, lists, directions, etc.
- Use information from books to get information and answer questions they may have.

Domain 5: Cognition & Knowledge of the World

What children need to know and understand about their world and how they apply what they know

Math

How children learn about math through real life experiences

Supporting at home and on the go activities:

- Count objects with your child. Touch each object as you count it and say the number.
- Help your child find patterns in everyday life (e.g., stripes on a shirt, colors on the rug, and stripes on a cat).

Science

How children learn about the world around them

Supporting at home and on the go activities:

- Let your child collect different things such as shells, rocks, leaves and sort the objects. Talk about how objects are the same and different.
- Talk about what things may be living and which are non-living. Keep a journal where you write down some of the things you observe.

Social Studies

How children learn about themselves, their families, their communities, roles people play, culture, past and current events

Supporting at home and on the go activities:

- Help your child develop a basic awareness of himself as an individual, as a member of a family and as a member of the community. Share stories with your child about when he was a baby and how he has grown.
- Talk about community workers and describe what they do.

The Arts

How children learn different kinds of music and ways to use different kinds of tools to create art

Supporting at home and on the go activities:

- Let your child create art with a variety of tools such as crayons, brushes, paint, sticks, Q-tips, etc.
- Let your child listen to music, sing songs, perform finger plays, and play various musical instruments.

Technology

How children learn about tools we use to do different work

Supporting at home and on the go activities:

- Help your child to identify examples of technology used in daily life.
- Allow your child to experiment with glue, tape, paper, cardboard, foam, plastic, wood, straws, or spools.

Name: _____ Month: _____

MY READING LOG

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Author

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**KIDS WHO READ
ARE THE ONES WHO
SUCCEED!**

