



Music and ... Math

Research Highlights

Ages 3 to 5 years old



Introduction

“Listening to and making music form strong connections in the brain.

These are the same connections that are used to solve math problems.”*

Before your child gets to school, he will have heard music on the radio, sung along to catchy tunes, and memorized favorite musical nursery rhymes.

Scientists have been exploring the connection between these early music experiences and learning mathematics, and realizing that music is great preparation for success in math. And it’s not just *listening* to music that prepares your child’s brain, but actually *making* music!

With all due respect to today’s scientists, their findings are validating what great thinkers from ancient times (not to mention music teachers and pre-school teachers!) have long suspected and observed. Pythagoras, the Greek mathematician, used math to make sense of musical theory. Boethius, the Middle Ages music expert, articulated some of his musical ideas using math concepts. Thankfully, one does not have to be a genius of these proportions to recognize and benefit from the music–math connection!

Early childhood is the perfect time to use music and movement to discover mathematics. Rhythm is pattern; comparing higher pitches and lower notes is measurement; counting out the 1-2-3 of a waltz uses numbers. So . . . how does Kindermusik leverage these natural and powerful connections?

GEOMETRY: *Shapes and Space*

What is it?

Geometry begins with understanding the shapes and structures around us in the world. One specific element of geometry is called spatial-temporal

* Sawyers, K. & Hutson-Brandhagen, J. (2004). Music and Math: How do we make the connection for preschoolers? *Child Care Information Exchange*, July/August 2004. For all other reference citations and a full version of this paper, please visit us at www.kindermusik.com/benefits.

reasoning. Imagine a chess player making a mental image of the game board to plot out her next move. That's spatial-temporal reasoning. The most famous scientist of our time, Albert Einstein depended on this ability to form mental images and move them around in his mind. Preschool children can develop excellent visualization skills, too, given well-planned experiences like music classes.

For young children, geometry is learned not just in their minds, but through their eyes, hands, and bodies, too! Spatial sense is about understanding location, motion, and distance, and is developed through movement. As children move their bodies and objects through space, they learn relationship concepts like *near*, *under*, *by*, and *on top of*, and deepen their understanding of positional and spatial concepts.



How It Works in a Kindermusik Class

Ready for some surprising science?

Young children who participate in music instruction show stronger spatial-temporal reasoning skills than those who don't. We're proud to share that

a published study of four- and five-year-old children in Kindermusik classes showed that these children developed stronger spatial-temporal reasoning skills than non-participating children. (By the way, if you've heard of the "Mozart

Developmental Milestones: *Geometry*

Preschool children demonstrate understanding of shapes and space when they:

- * Form a triangle using three sticks.
- * Tell you that wheels or bubbles look like circles.
- * Construct elaborate towers using pots and pans.
- * Say, "I shook my bells over my head. Now watch me shake them behind my back!"

NOTE: Every child is unique, and different children may reach milestones at different times. If you're concerned about your child's development, talk to your pediatrician.

effect” involving the benefits of listening to music, notice that these more recent studies actually show long-term impacts from children making music, too.)

What is it about music classes like Kindermusik that improves geometry skills? As you know, it’s not that children spend time talking about shapes. It turns out that **as your preschooler makes music, certain neurons in the cortex of his brain start firing.** And the brain pathways that are created by making music are the same ones used for more complex spatial-temporal reasoning tasks. (Wow!)

It’s probably easier to see how Kindermusik classes build spatial sense; just see your child move his hands when the teacher says “*up high*” and “*down low*”. Expert educators explain that moving to music helps preschoolers become “increasingly aware of the space within and surrounding their actions.” Who knew that directing all that wiggling energy would build important geometry skills?



What You Can Do at Home

- * **I Spy Shapes.** Challenge your child with questions like, “Can you find something *square* that is *next to* the door?” or “I see something *round* that is *on top of* the table. What is it?”
- * **Billy Goat’s Gruff.** Act out the popular story, asking your preschooler to hide “*under* the bridge” or “*on top of* the bed”.
- * **Hidden Pictures.** Draw simple pictures using circles, squares, and triangles—a dog, train, and snowman make good starters. After your child looks at a picture, hide the picture and ask her to draw it from memory.

Patterns



What Are They?

Has your preschooler noticed the many sequences and arrangements around her in the world? Day follows night, the kitchen tiles go white-black-white-black, snack comes after nap . . . Those are simple patterns! Soon after these informal understandings, your child begins to explore patterns in physical objects like colored blocks or differently sized cups. Your preschooler's brain begins to grasp the rules behind patterns—she figures out the rule, sometimes figures out how to put the rule into words, and predicts what will come next in the pattern following this rule.

How It Works in a Kindermusik Class

In addition to working with patterns using physical objects, leading math educators recommend working with patterns of movement and sound.

These experts explain that music is a great tool to engage children in exploring challenging math concepts, and that working with rhythms sets them up to

Developmental Milestones: Patterns

Preschool children demonstrate understanding of patterns and relationships when they:

- * Imitate a pattern of movement (clap, stomp, clap, stomp...).
- * Line up toy cars in a simple pattern (red, black, red, black...).
- * Extend a pattern of colored blocks, e.g., adding red and blue blocks to an existing pattern of red, red, blue, red, red, blue.
- * Create or imitate a pattern of sound (shake-shake-shake, shake-shake-shake...).
- * Understand the sequence of events when Daddy explains, "First we plug the drain, then we run the water, and then we get in the bath."

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understand patterns. From simple steady beats to complex rhythms and repeated choruses, music is filled with patterns.

Kindermusik classes make rich use of music and movement to explore patterns. Your teacher guides the group in listening for changes in a musical pattern—for example, when a clock’s steady tick-tock changes to the “bong!” of a chime. In echo songs, your child repeats a simple pattern and rhythm like “Hello Margie!”, “Hello Miss Anna!” etc. During instrument play-alongs, your child practices echoing the boom-boom (1, 2) pattern your teacher plays on a drum. And, in movement games, your child translates the 1, 2 pattern he hears from the shared instrument into a 1,2 pattern he makes with his body. (Can you believe this is getting your child ready for algebra?)



What You Can Do at Home

- * **Brown Bear, Brown Bear.** Read a story with repetitive text. Afterwards, playfully challenge your child to come up with new “pages” that match the repeating pattern.
- * **Stuck at the Curb.** Point out the pattern and sequence of colors on a traffic light: it turns green, yellow, then red over and over again. Or, try the same thing with the walk, flash, and stop symbols on a crossing signal.
- * **Paper Quilts.** Make a simple “quilt” by cutting out different colored squares of paper. Start with patterns that repeat horizontally, then try cutting the squares into triangles for more challenge.
- * **Follow My Lead.** Make up a simple repetitive dance routine, narrating to your child as you move (“Stomp, tap, clap! Stomp, tap, clap!”), then see if your child can repeat the pattern.

Number & Measurement

What Are They?

Ask your preschool-age child about math, and he may say, “it’s about numbers and counting.” Researchers explain, “Not only are counting competencies essential ‘survival skills’ in their own right; they provide a basis for the development of number and arithmetic concepts and skills.” Your child will be moving from “rote counting” (where she recites numbers by memory) to “rational counting” (where she will count actual objects correctly). Think about the challenge: answering “how many?” means not only getting the number sequence correct (1, 2, 3, 4, 5), but also answering with the last number word used in the count (the “cardinal word” principle). Getting to, knowing it’s the answer, and saying “five!” is a big step!

“I’m bigger than you!”, gushes your excited child on the playground. That’s measuring!

Researchers tell us that preschoolers are developing important measurement concepts during the ages of 3–5. Well before your child uses numbers on a ruler to measure length, she is learning to think



Developmental Milestones:

Number & Measurement

Preschool children demonstrate understanding of number and measurement when they:

- * Verbally count by ones in the correct order up to ten and possibly beyond.
- * Guess that it will take ten blocks to make a bridge, then count to see if her guess was right.
- * Show that he is four years old by showing four fingers on his hand.
- * Answer, “three!” when given two cookies and asked how many she would have if you gave her one more.
- * Count how many cups of water it takes to fill a bucket.
- * Say, “I’m more than you—I’m four and a half!”

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about measurement by making comparisons like bigger/smaller (size) or faster/slower (speed/time).

How It Works in a Kindermusik Class

“Preschoolers see the world as an arena for counting. Children want to count everything.” Kindermusik classes build on your child’s natural enthusiasm by integrating numbers into music and movement activities. As your child sings “Ten in a Bed”, she is mastering a number sequence. Researchers suggest that children depend on these early number songs and rhymes to build more complex number skills later on—for example, when adding $3+4$, they might depend on the memory of “4, 5, 6, 7”. Counting to a tune or to a rhythm and then matching those numbers to movements deepens your child’s early math skills!

In Kindermusik classes, your child also gets playful experiences with measurement. Think about this: a musical scale is a series of sounds arranged by pitches. Your child compares the lower sounds and the higher sounds, hearing them in equal mathematical units (without calling them that, of course!). How about: is this drum beat faster or slower? Rhythm listening and comparing gives your child many opportunities to measure and compare time intervals.



What You Can Do at Home

- * **Guesstimate.** Who has more green beans, Mom or Dad? How many dogs will you see on the way to the grocery store? Each of you make a guess, then count out loud to see who was right or who was closer.
- * **Make a Number Book.** Take your child’s favorite counting song and make it into a number book. For example, “Once I Caught a Fish Alive” is a great song for drawing fish.



* **Morning Math.** Motivate your sleepyhead to get moving in the morning by working on measuring the time it takes to get dressed. If it took 10 minutes today, can we do it in fewer minutes tomorrow?

Conclusion

Music and mathematics are a natural fit, and research is beginning to prove it: **playing music can actually make young children stronger mathematicians.** From geometry to patterns to numbers and measurement, Kindermusik classes have been carefully constructed to give your child experiences rich with mathematics-learning opportunities. So play that drum and shake that shaker and sing those counting songs with a one-two-three. **Believe it or not, your child is learning math!**



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