HELPING YOUR CHILD DEVELOP SKILLS FOR MATH AND SCIENCE

As parents, we want our kids to develop the mental skills they need to succeed in school and beyond. Research from cognitive science and educational psychology have shown that a specific kind of mental skills – spatial thinking – is important for success in math and science. Spatial thinking refers to a set of mental skills involving reasoning about space and spatial relations. You use these skills to find your way using a map, choose the right size container to store leftovers, or use a diagram to install a car seat.

Research shows these skills are important for Science, Technology, Engineering and Mathematics (STEM). Students who are more advanced spatial thinkers are more likely to enter into and do well in STEM courses and careers. You may feel like you are not good at this type of thinking, but spatial thinking is a skill that can be improved. **How can you help your child develop spatial thinking skills?** Here are three activities we think can help.

1. **Play with puzzles**
   Children who play with puzzles, and play with them often, tend to be good at spatial thinking. A study at the University of Chicago asked what types of play activities at home help children develop spatial thinking skills. Researchers observed children ages 2, 3, and 4 playing in their home with their parents. When the kids were 4, researchers gave them a shape transformation in which they chose which shape (Figure 1: A, B, C or D) would be made by moving two separate pieces together (e.g. triangles shown below on the left). The correct answer is D.

   ![Figure 1. An example of the shape transformation task](image)

   They found that the more children played with puzzles, the better they tended to do on this task. This was true even when variation in parent’s income, education, and a variety of other factors were taken into account. This study is *correlational*, meaning that it shows a relationship between puzzle play and spatial thinking skill. It does not tell us that puzzle play causes good spatial thinking skills. However, this work suggests that kids who play with puzzles more often tend to be better at spatial thinking.

   **What does this mean for parents?** When looking for a fun, interactive activity for your child, why not play with puzzles! Like shared book reading, puzzles can promote interaction between you and your child and encourage spatial problem solving.

2. **Play with blocks**
   Other studies have shown a link between better spatial thinking skills and frequency of playing with blocks. Indeed, research suggests that teaching kids different methods for building with blocks can facilitate performance on the Block Design task. In this task a child is shown a picture of a red and white 2-dimensional pattern and asked to use colored cubes to recreate the pattern. When kindergarten teachers taught students principles of
block building, such as how to use blocks to make a bridge or how to combine blocks to make a building, performance on the Block Design test improved compared to children who were not taught these skills. This indicates that teaching kindergarten children block building methods can help develop their spatial thinking skills.

Block building has also been linked to emerging math skills in pre-school children. Researchers gave 3-year-olds a preassembled block model (shown here) and separate pieces and asked them to copy the structure. They then looked to see if how well a child could correctly build the structure was related to mathematical skill. At age 3 this consists of asking kids to count as high as they can without making a mistake or to give a researcher a specific number objects (i.e. 4 crayons). The children who were better able to copy the block model performed better on these math tasks. This study does not tell us that playing with blocks will improve math skills. However, it suggests children who are good at spatial thinking also tend to have good early math skills.

What does this mean for parents? Parents can encourage block play. While playing, help set a goal for your child such as building a tower for a princess or ramp for a car. Ask them how many blocks of one size it would take to cover a block of another size or which shaped pieces they think would be best to build an arch or a stairway. Block play may encourage kids to think about cornerstone math concepts such as quantity, size, shape and symmetry.

3. Talk about space and spatial relationships
Can parents’ talk influence their child’s spatial skills? Researchers at the University of Chicago asked whether there was a connection between the number of spatial words (e.g. tall, parallel, hexagon, on, below, flat) a parent used during play and the child’s 1) production of spatial words, and 2) spatial thinking performance. They videotaped children between the ages of 14 months and 4 years interacting naturally with their parents and then at age 4 1/2 gave them several measures of spatial thinking including the shape transformation task used in the puzzle study. Results showed that parents who use more spatial words also have children who use more spatial words, and that children who use more spatial words are likely to be better at spatial thinking at 4 1/2 years. We don’t know for sure that if you use spatial language your child will be good at spatial thinking, but this study suggests that spatial language may be one route to supporting spatial skills.

What play situations best encourage the use spatial language? A study at Temple University compared parent and child use of spatial words in three play situations. In the free play group parents and children were asked to play with a set of blocks like they would use at home. In the guided play group they were given diagrams showing steps to build a structure (e.g. a garage). In the preassembled play group they played with a preassembled structure. Results showed parents and children in the guided play group produced the most spatial words.
What does this mean for parents? There are plenty of opportunities for parents to use spatial words when interacting with their child. For example, it might be fun to ask your child what direction to turn when you are driving home. Or talk to your child about shapes, sizes, number of objects, whether something is long, short, tall, thin, etc. The next time you play with your child, why not try to use words that draw their attention to spatial properties of toys, such as talking about straight edges versus curvy middle pieces of puzzles or size, shape, and quantities of blocks or building pieces.