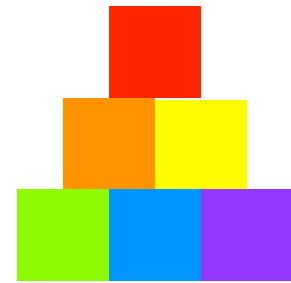


# Engaging Girls in Spatial Play Through Storytelling

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## Is there a gender gap in math?

- Whether there is a male advantage in math performance is widely debated (Casey, Nuttal & Pezaris, 1997).
- A ten-year trend in Ontario EQAO results shows that the percentage of girls who achieved Provincial Standard (Level 3) exceeded or was equal to male students' achievement rates (EQAO, 2016-2017, p. 29).
- There are consistent findings that show a gender gap favouring males in spatial skills, which have been shown to relate to specific math content areas (e.g. geometry) and mathematical problem solving (Kersh, Casey & Bryden, 2008; Reilly, Neumann & Andrews, 2016).
- Spatial skills are malleable and can be improved (Reilly, Neumann & Andrews, 2016).

## Differences in Play Preferences

- At the age of 3 months, infants in the UK begin to show toy preferences (Todd et al., 2017).
- Girls usually gravitate towards toys that foster language and social skills, while boys are attracted to toys or games that foster spatial reasoning skills.
- In kindergarten classrooms, this same trend is observed and is often seen to be indirectly or subconsciously promoted by the teacher (Granger et al., 2016).

## Differences in Literacy Skills & Preferences

- EQAO data show females outperform males in Language 100% of the time by a margin of 8% to 13% in Reading and by a margin of 11% to 15% in Writing (EQAO, 2012, p. 25; EQAO, 2016-2017, p. 29; EQAO, 2018, p.8).
- Between 2009 and 2018, 10-17% more Primary girls than boys said "I like to read" (EQAO, 2012, p.10; EQAO, 2017, p.10, EQAO, 2018, p.28).

## Differences in Problem Solving Approaches

- Although most research indicates no achievement gap in math between boys and girls in the primary years, it was found that girls in 2nd grade were more likely to use concrete solution strategies and boys were more likely to use abstract solution strategies (Fennema et al., 1998).
- Girls rely more on verbal skills in kindergarten to solve math problems whereas boys tend to rely on spatial reasoning skills to complete the same task (Klein et al, 2009).
- When testing for creative thinking, boys score higher "boundary-breaking thinking" and girls score higher on "thorough thinking" (He & Wong, 2011).

## Differences in Spatial Awareness

- Research has found that males outperform females on spatial reasoning tests (Ministry of Ontario, 2014).
- Studies have found that these gender differences may be caused by the way the math questions are asked rather than the content itself (Casey et al., 2008).

## Long Term Implications

- Research has found that spatial ability predicts success in solving word problems, measurement, geometry and calculus, all of which are especially important in STEM careers (Ministry of Ontario, 2014).
- Gender differences in mathematical achievements are found to be greater at the high end of the performance distribution, which is important for understanding the underrepresentation of females in STEM fields (Stoet & Geary, 2013).

# Storytelling Workshop

## Why Incorporate Storytelling in Spatial Play?

- Evidence shows learning new concepts through the context of storytelling improves learners' retention and recall (Bower & Clark, 1969; Graesser, Hauff-Smith, Cohen & Pyles, 1980; Mishra, 2003).
- Studies show embedding mathematics within a narrative has motivational benefits. For example, intervention groups were more willing than control groups and more frequently engaged with math during free play (Cordova & Lepper, 1996; Hong 1996).
- Casey et al. (2008) found that girls' spatial skills improved the most with a storytelling and block play intervention but the least without storytelling; boys improved the same amount regardless of the inclusion of storytelling (p. 37).

## Ideas for Using Storytelling in Spatial Play

- Use the characters in the story to ask students to help solve block building problems, this draws them into the story as well as the mathematical content and provides a rationale for the tasks you are asking children to do.
- Actively involve students in the story telling. For example, In Beth Casey's *Sneeze Builds a Castle* story, students imagine riding on Sneeze's back, the dragon puppet, to the Land of Castles
- Have your characters encounter multiple adventures, where each new problem builds on the students' skills acquired in previous adventures.
- During building, use the characters and the rationale of the story to help bring children's focus and attention back to the mathematical skills you are focusing on
- End with a culminating task that incorporates all previously gained skills (Casey et al., 2004).

## Example Story

- A variation of the 3 little pigs where their Uncle Herbert has come to town warning them of the big bad wolf.
- As the wolf approaches each house, the students have to help the pigs create a variety of barriers to protect the pig's house.
- Barriers can include a wall, bridge or castle around the house.
- Teachers are encouraged to include a interactive chant or movement throughout the story to increase student engagement.
- Teachers can adapt the activity by providing students with either one type of building material or multiple types.

## Tips for Teachers

- Teachers should model spatial words such as outside, inside, front and back through gestures.
- Teachers should encourage students to use their hands and gesture the movements they are discussing.
- Use jigsaw puzzles as they have been linked to strong spatial thinking, especially when paired with the proper spatial terminology.
- Incorporate activities such as origami or video games such as Tetris to deepen spatial knowledge (Newcombe, 2010).