

Math 4 Young Children

OAME

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A focus on spatial thinking
and playful pedagogy

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www.tmerc.ca

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The Teaching and Learning of Young Children (JK-Grade 2)

Thinking Spatially

Most of us have been taught to think and talk about the world using words, lists, and statistics. These are useful tools but they do not come close to telling the full story.

Thinking spatially opens the eye and mind to **new connections, new questions, and new answers.**

Center for Spatial Studies
spatial@ucsb

According to Ontario Curriculum_(Forward)

- Spatial sense is the intuitive awareness of one's surroundings and the objects in them.
- Spatial sense is necessary for understanding and appreciating the many geometric aspects of our world.
- Students develop their spatial sense by visualizing, drawing, and comparing shapes and figures in various positions.

Our growing list...

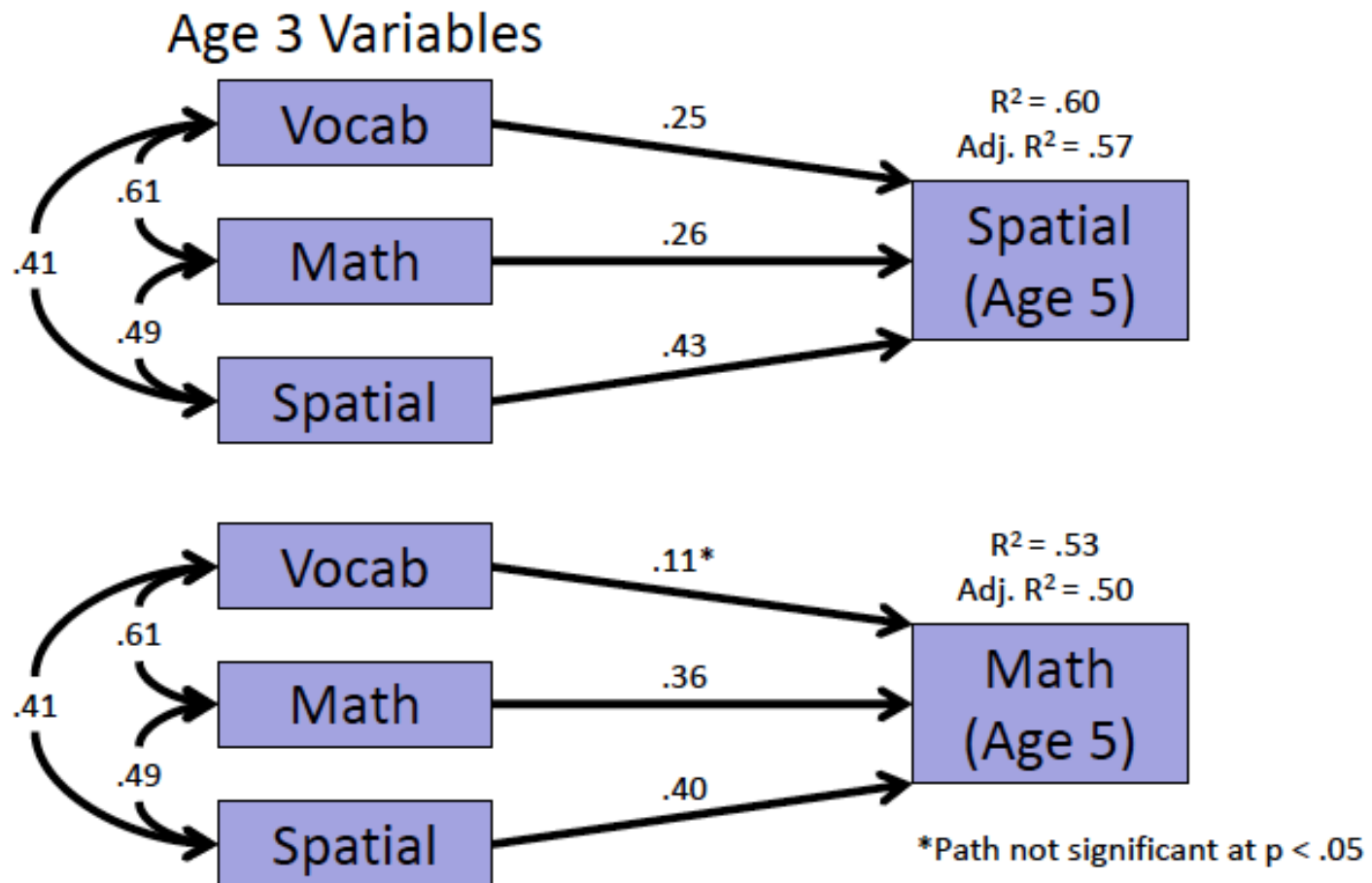
- Symmetrizing
- Balancing
- Locating
- Orienting
- Decomposing/
recomposing
- Shifting dimension
- *Diagramming*
- Connecting
- Navigating
- Transforming
- Comparing
- Scaling
- “Feeling”
- Visualizing

Why is spatial reasoning important?

- Spatial reasoning is predicting mathematics abilities, even more than math itself (Verdine, Farmer, et al)
- Empirical evidence indicates that spatial imagery reflects not just general intelligence but also the ability to solve mathematical problems, especially non-routine problems (e.g., Casey, Nutall & Pezaris, 1992, 1997, 2001; Wheatley et al. 1994)
- And Mathematics is predicting overall success (Duncan, Clausens et al)
- Essential for **STEM careers** (Newcombe, 2010)

Spatial Reasoning is Key

Figure 2. Path models for regressions predicting Age 5 Math and Spatial scores



Spatial Reasoning is Malleable

Spatial reasoning can be learned through effective programming starting in the early years, but also later (Feng, 2007; Uttal et al, 2012)

- Video gaming studies (tetris, first person shooter games, army training) (Terleki, Newcombe, Little, 2008)
- Levine task and M4YC task training effects

A nice article to start with is Newcombe's 2010 "Picture This" article in American Educator

2D mental rotation: “Levine Task”

Practice effects with 16 spatial test items (Cheng & Mix 2011; Erhich, Levine & Goldin-Meadow, 2006; Wright et. al. 2008) improve spatial reasoning skills.



Math for Young Children Project

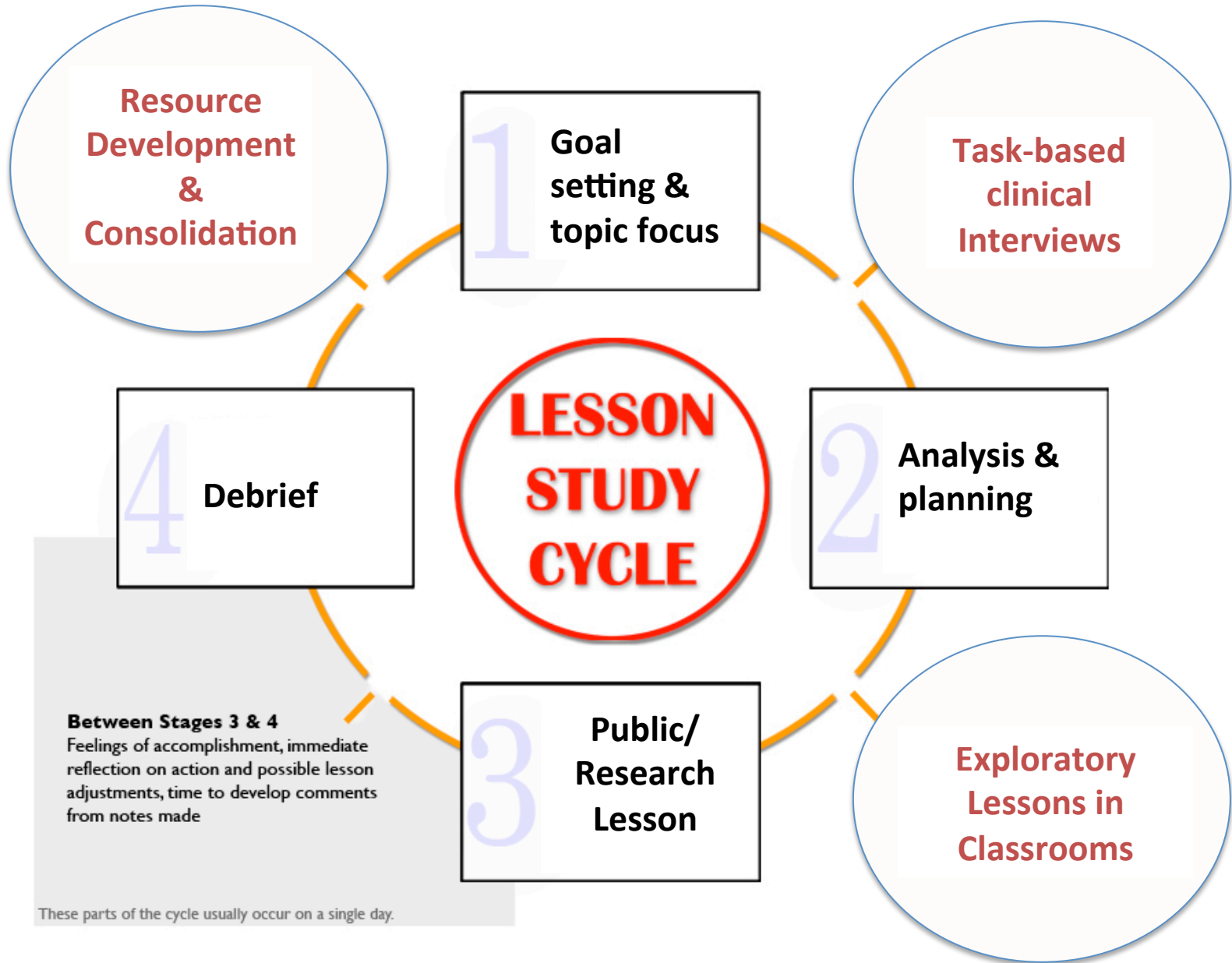
- SSHRC and Ministry funded, Ontario classroom-based research
- JK to Grade 2, small teams of teachers
- Focused math content (with a spatial reasoning lens)

Sample topics:

Linear measurement, conservation of area, perspective taking, perimeter, mental rotations, composing and decomposing figures / numbers

Resources at: www.tmerc.ca

M4YC LESSON STUDY MODEL

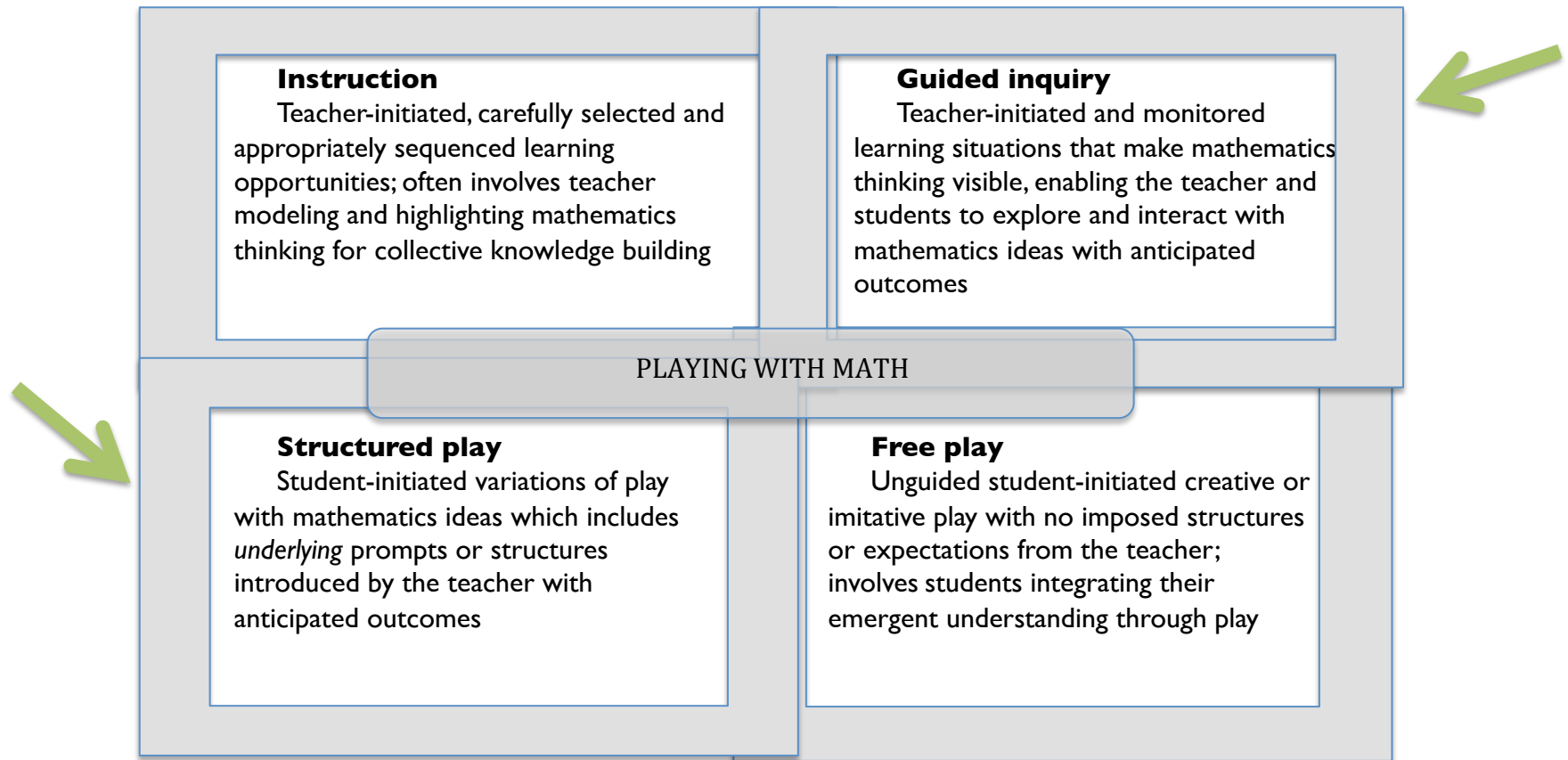


Free Play ONLY is Insufficient

It is “...increasingly evident that free play is not sufficient to promote solid mathematics learning, for many children, particularly the poor, who have the greatest need.”

(Ginsburg & Ertel, 2008)

What do we mean by Playful Pedagogy



Bruce, C. & Flynn, T. (2012). Integrating instruction and play in a Kindergarten to Grade 2 lesson study project. In L.R. Van Zoest, J.J. Lo, & J.L. Kratky, (Eds.), *Proceedings of the 34th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Kalamazoo, MI: Western Michigan University.

Try Out Some of the Tasks

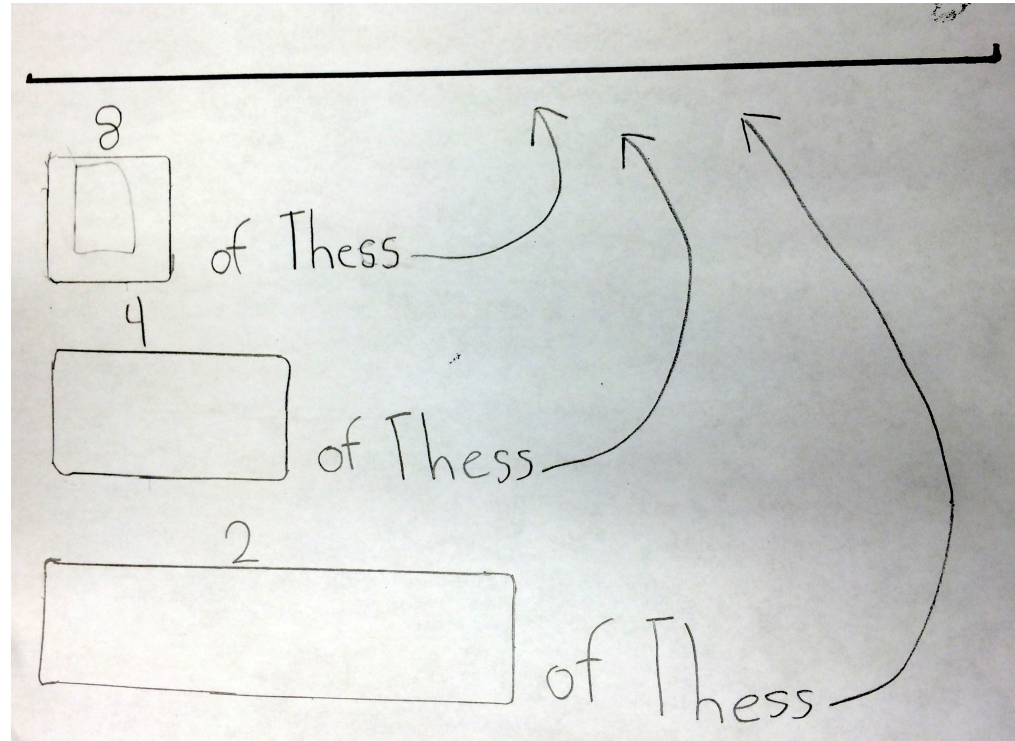
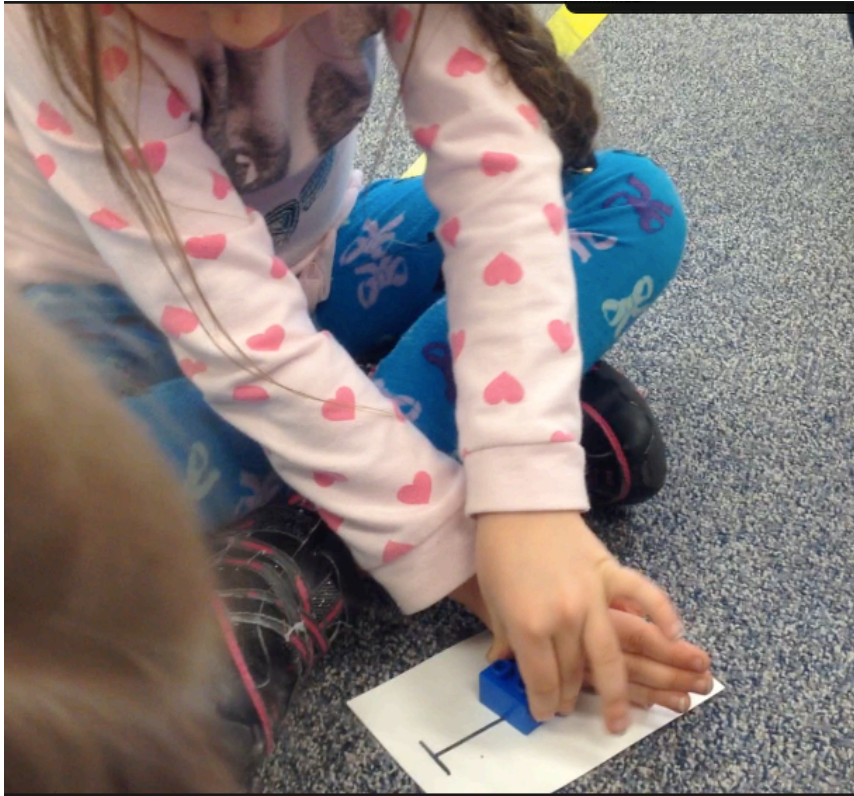
- 5 tasks in your package
- 1 messy box for every 5 people
- You will have time to try these out and reflect on implications (for children, for you in your role)
- Then we will have a larger group discussion (with Q and A)

The Messy Box



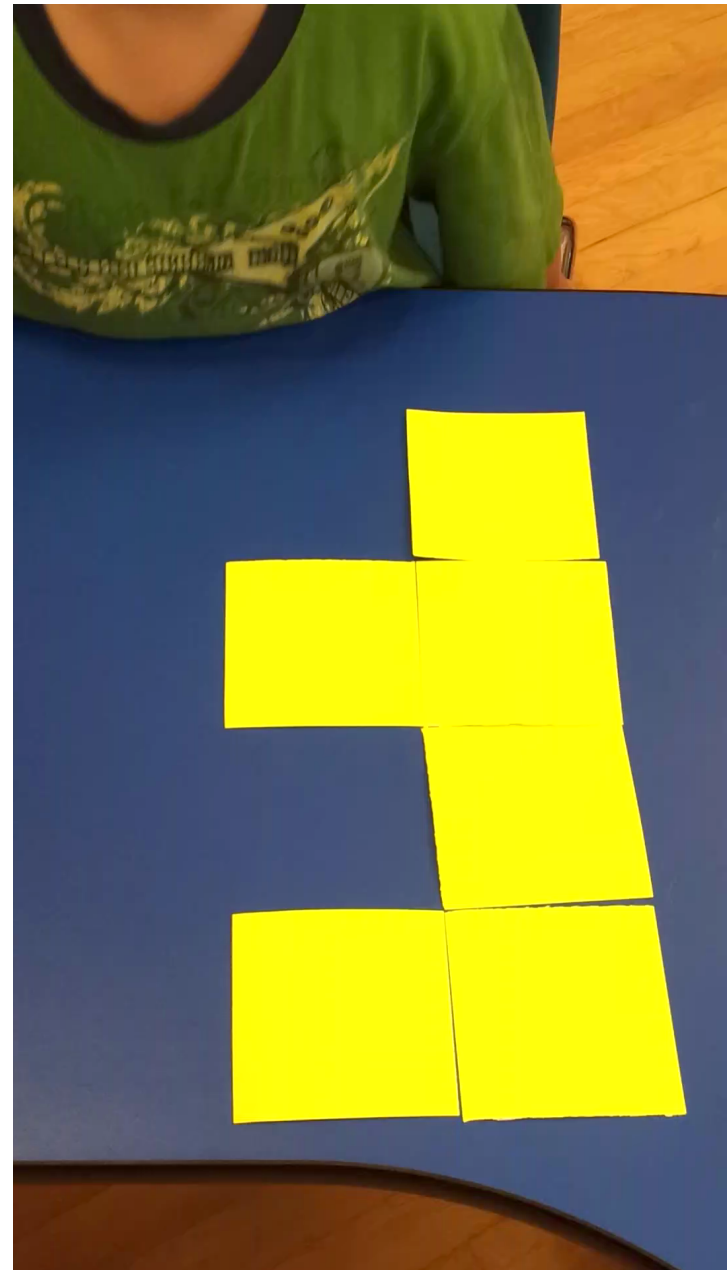
Children's Responses

Task 1



Children's Responses

Task 2



Children's Responses

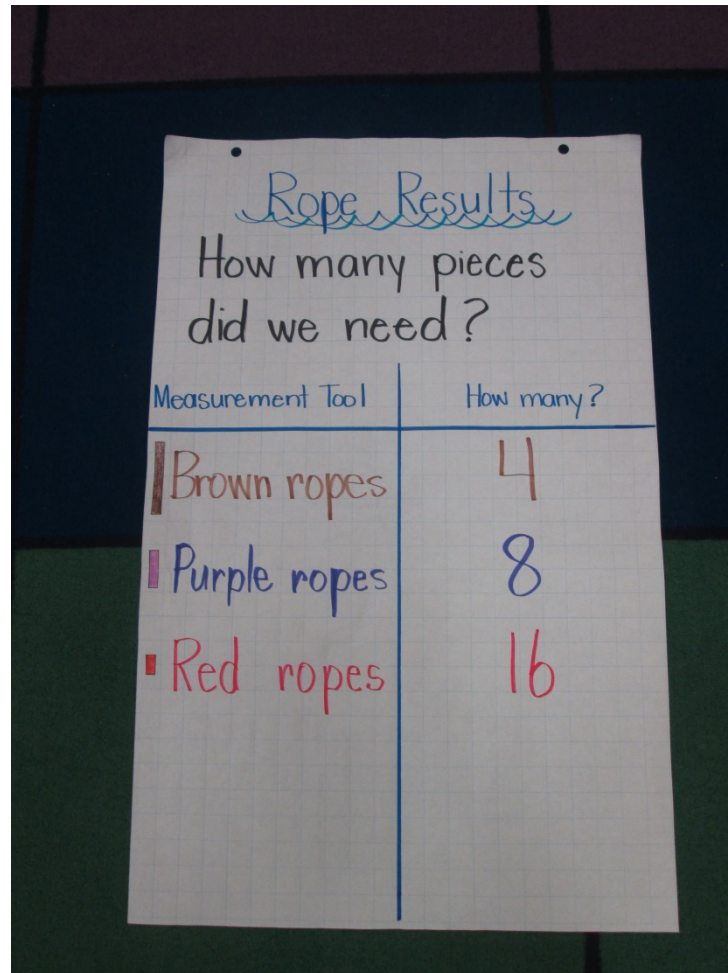
Task 3

Visualize, Verbalize, Verify



Children's Responses

- Task 4



Rope Results
How many pieces did we need?

Measurement Tool	How many?
Brown ropes	4
Purple ropes	8
Red ropes	16



Children's Responses

- Task 5

Top, Front & Side Views

