Learning Lab 8: Geometry: Spatial Relationships and shapes

Materials for the session:

- **Instructors' preparation**
- Chapters in Big Ideas of Early Math: Spatial Relationships and Shapes
    1. 2 Research Lessons: Rosie's walk and Feel for shapes including videos
    2. Facilitator's Guide and PPT
    1. Evaluation/reflection sheet (not included)

- **Suggested materials**
    1. Rosie's Walk by Pat Hutchins
    2. Grid paper, pencils,

Rationale for Session Focus:

This is the last session for KCM- EMC math. A lot gets packed into it. In the book, the discussion of geometry is done in two chapters but we are putting both topics together because of scheduling.

Because it is the last session, we should spend some time reminding participants of the through line that the series takes, beginning with sets and sorting, patterns and then moving to number (3 sessions), measurement, data, and finally geometry. In the following paragraphs, I hope to "unpack" the way mathematics and mathematical thinking involves all the traditional topics or subdisciplines.

Based our own school experiences, adults tend to think of geometry as being all about shapes—and that being able to label common shapes is all children need to know until they get to high school and do "real" geometry which is about proofs and definitions.

In general, non-mathematicians do not realize that movement and direction (mapping) is a mathematical activity, as are calculating measurements of area and perimeter. Furthermore, all of them belong are part of the specific topic of math called geometry. The fundamental characteristic of geometry is the creation of increasing precise descriptions that lead to categorization (backs to sets and sorting and patterns). The descriptions include a fairly complex cluster of **specifically mathematical attributes**, including attributes of number.

Shapes for examples, are defined first by whether they are 2 or 3 dimensional

For regular shapes, the definition gets increasingly complex as more of the attributes of shape are defined.

- Type of line—straight or curved
- Number of lines (edges-3D); Number of sides(faces)
- Length of lines

- Number of angles
- Measurement of angles (
- In formal geometry as in high school, the definition also includes slope of the lines and other relationships (sine,cosine, tangent, etc)

Spatial relationships, sometimes called Movement and Direction, allow us to define/describe relationships between objects and places, including specification of how to move between two points.

- While the attributes of shape are fixed for a given shape, Spatial relationships depend on **attributes of relative position**, which means prepositions such as *next to, under, above, right, left, e*tc; like attributes of size *(bigger, longer, heavier* etc) the relationships are not fixed but change depending on what is being compared (this goes back to measurement as in "Next to an Ant")
- As we noted in measurement, *relational terms are complex*—and are among the last classes of words that develop in children's language. Just as we focus in measurement on "What kind of bigger is it?" in spatial relationships we focus on *how to get from here to there or there to here* in more general schematic terms—a very concrete kind of mapping that they begin to realize can be represented pictorially or mentally visualized—they also see the advantages of adding measurement attributes (*go straight for a while* might become *go for one block*….)
- For 0-3, awareness of and navigation through the world is extremely important but remains at an experiential, intuitive level—it is inappropriate to push them to any cognitive expression/definition.
- 3-5 year olds are developmentally able to begin this process—and in fact they see the usefulness of being able to "name" shapes and describe spatial relationships—the level at which they do so, however, is emerging. If they are to develop the foundation for more complex mathematical thinking, they should be supported from the beginning to recognize that there is a "pattern" in how common shapes can be categorized —including type of line, number of sides and angles (corners).

Time	Activities and Key Points	Rationale
10-15 mins	**Reflective practice discussion** Participants use post-it notes to complete Geometry is…. Have them post them before beginning review of RL 1. Research Lesson *Shoe Sorting Graph*—what went well, what might you do differently> Turn and Talk and quick share	Reflective practice and sharing with other in this community of practice deepens participant's understanding and productively supports them to feel competence, while finding ways to do better.
10 min	**Introduction: Activating thinking about geometry** 1. Teachers go through obstacle course. Course should have 4-5 elements and be made of things already in the room. 2. Teachers line up at beginning of course, and as they go through, the group chants together: "Good morning, I'm Mary." "Good morning,	Invite teachers to use their first language, if possible. Hearing the obstacle course directions in one's first language is important because movement and location words have relative meanings that change from language to language.

	Mary. **Go over** the line, **around** the table, **between** the chairs, and **under** the bridge" (two people holding up arms). 3. Can the teachers guess what strand we are focusing on today	The obstacle course draws attention to the relational words (prepositions) we use to describe movement and directions
60 mins Book: Rosie's walk	**Let's Do Math** 1. Ask teachers to listen to the story *Rosie's Walk* and make a map that will chart the course of Rosie's walk. Read the story but do not show the pics. Participants share and discuss the paths they drew; highlight that the last lines of the text make Rosie's walk *a closed path*. Introduce the idea that 2 dimensional shapes are closed paths—whether they are regular or irregular. 2. **Pose the problem:** How could you describe (make a map) of Rosie's walk that is more precise? What elements could be made clearer or more specific (some kind of measurement of the direction such as go left for 5 feel then go around the pond or whatever. 3. Each person is to draw a map for Rosie's walk. They should not share their drawings. • The path is to be done on grid paper. • The closed path should end up being a regular shape (triangular, circular, rectangular) Form partner teams to do a kind o "Battleship" task. Partner A does not show her map but gives B directmathematical attributes ions about how to draw it on a blank piece of grid paper. The direction giver can only give directional prompts and the partner can ask questions related to movement and directional –they may not describe the final path in any global way (the path is circular) When the drawing is finished they compare the drawing with the original map. Partners switch roles and repeat.	Rosie's Walk is a wonderful demo of the powerful interplay between texts and pictures/ But it also is a great intro to one of the most salient ways that math is all around us –and how math allows us to give precise definitions and directions. The story itself creates a very schematic path—and it is only at the end of the story that we realize it is a *closed path* You might want to point out that the closed path is the *perimeter*, the region inside the closed path is the *area* Drawing Rosie's Walk on grid paper as a "Battleship Game kind of activity is an adult activity—emphasize that it is not something they should expect young children to do—though, as they will see in the research lesson, young children can describe and represent paths and shapes in more generalized terms.
30	**Let's Talk about it** 1. Debrief on the representing Rosie's path experience	

	2. What did they notice about the task? 3. What were some challenges ? 4. How did the activity change their thoughts about the original responses to the *Geometry is….* Notes at the beginning? 5. What are your thoughts about why the activity was structured as it was? 6. What are your thoughts about how this activity was intentionally structured? **Developmental Considerations** If time, have small groups discuss one of the developmental considerations briefly and then report back to the whole group 1. Movement in space is a basic and powerful experience that helps develop spatial sense; children need to talk about, plan, and organize such movements 2. Perspective-taking is just developing in many children of this age – they will need a lot of exposure to the idea that things look different depending upon where the viewer is, and that words describe directions *relative* to a particular point of view 3. English language learners will benefit from directions (*up, next to*) described in the language they know best	
1 hour	**What does Learning Look Like** Show 2 Research Lessons: Before each, show Big Ideas and Skills slide, discuss briefly then watch the video. After video : Ask group to turn and talk , using the Big Idea and Skills charts for the lesson—discuss how the Big Ideas and Skills played out in the lesson **Research Lesson 1: Rosie's Walk** *As a movement break put regular 2-d Shapes on their back, they can only ask attribute questions to figure out which shape they are. Then have them sort themselves into quadrilaterals, triangles, and other* **Research Lesson 2: Feel for Shapes**	Stickers that show regular shapes such as different kinds of quadrilaterals (including rectangles square rhombus and trapezoid) triangles, pentagon PDF of slides Research Lessons

	additional discussion questions for both lessons 1. How does the teacher give ownership of the lesson to the children? 2. What are ways the teacher supports children's language development? 3. What evidence do you see that children are engaged and are actively constructing their own understanding?	
10	**Reflecting on today's learning** **Make a word wall**	Reflection sheet