TEACHING PRESCHOOLERS ABOUT 2-DIMENSIONAL SHAPES

By Sallee Beneke

Learning about shapes has been identified as a priority for preschool-aged children by organizations that set standards for early childhood education (National Research Council, 2009; NAEYC, 2010). While older preschoolers begin to learn about 3-dimensional shapes (3-D), the primary emphasis for preschoolers is on 2-dimensional shapes (2-D). Children's understandings of shape concepts provide a foundation for mastery of more advanced number and geometry concepts in later grades. However, research reveals that preschool children in U.S. classrooms typically develop a poor understanding of shapes (Clements & Sarama, 2014). It is important for early educators to recognize that preschoolers' competency with shapes extends beyond being able to recognize the standard triangle, circle, square, and rectangle. This guide for teaching preschoolers about 2-D shapes provides an overview of preschoolers' shape competencies, the developmental continuum for learning about shapes, and teaching strategies that can help young children learn about shapes.

Preschoolers' Shape Competencies

For young children to develop competency in understanding 2-D shapes, educators need to recognize the multiple processes that must be mastered. Learning about 2-D shapes includes recognizing whole shapes, as well as recognizing parts and features of these shapes. For example, preschoolers are capable of recognizing that shapes have an inside region and an "outer boundary" (National Research Council, 2009). They can learn that all shapes, other than the circle, have straight sides. Preschoolers can also analyze and name shapes by counting the sides and observing the relationships of these sides (e.g., parallel, perpendicular, longer, shorter). Young children can notice that vertices or corners connect lines or shape sides, and they are able to discover that a shape has the same number of vertices as it has sides. Preschoolers are gradually able to categorize shapes (e.g., triangle, rectangle, circle) and see that within each category there are many variations (e.g., there are right triangles, isosceles triangles, and equilateral triangles). Through discovery learning, they can grasp that a square is a special kind of rectangle. In addition, preschoolers begin to recognize shapes when they are rotated in a variety of directions and are viewed from different orientations.

Experts in the field of early mathematics have described developmental pathways or trajectories for children's recognition of shapes that increase in difficulty. As young children learn about shapes, their recognition skills, "cover a range of difficulty, including perceive, say, describe/discuss, and construct" (National Research Council, 2009). This developmental view of shape recognition and awareness is summarized in Table 1.

Table 1. Steps/Ages in Learning to Think About 2-D Shapes*

Steps/ Ages	Skill	Related Competencies
STEP 1: Two & Three Year Olds	1.1 Thinking visually/holistically	Recognition and informal description (including at least circles, squares, then triangles, rectangles).
	1.2 Thinking about parts	Shapes by number of sides (starting with restricted cases, e.g., prototypical equilateral triangle, square).
STEP 2: Four Year Olds	2.1 Thinking visually/holistically	Recognition and informal description at multiple orientations, sizes, and shapes (includes circles and half/quarter circles, squares and rectangles, triangles, and others [the pattern block rhombus, trapezoids, hexagons regular]).
	2.2 Thinking about parts	Describe and name shapes by number of sides (up to the number they can count). Describe and name shapes by number of corners (vertices).
	2.3 Relating parts and wholes	Recognize sides of same/different length, including right vs. non-right angles
STEP 3: Five Year Olds	3.1 Thinking visually/holistically	Recognition and informal description, varying orientation, sizes, shapes (includes all above, as well as octagons, parallelograms, convex/concave figures).
	3.2 Thinking about parts	Recognition of shapes by number of sides and corners (including new shapes).
	3.3 Relating parts and wholes	Measure of sides (simple units), gross comparison of angle sizes.

**Adapted from Cross, Woods, & Schweingruber (2009)*

Strategies for Helping Preschoolers Learn About Shape

Engaging young children in the following five mathematical processes helps them develop and communicate their thinking about all areas of mathematics, including geometry (National Council of Teachers of Mathematics, 2000). These mathematical processes are: (a) representing, (b) problem solving, (c) reasoning, (d) connecting, and (e) communicating. Educators can teach children to use these five processes to *mathematize* or relate shape concepts to their everyday world. Tables 2 and 3 provide examples of language and materials that teachers can employ to help children use these processes.

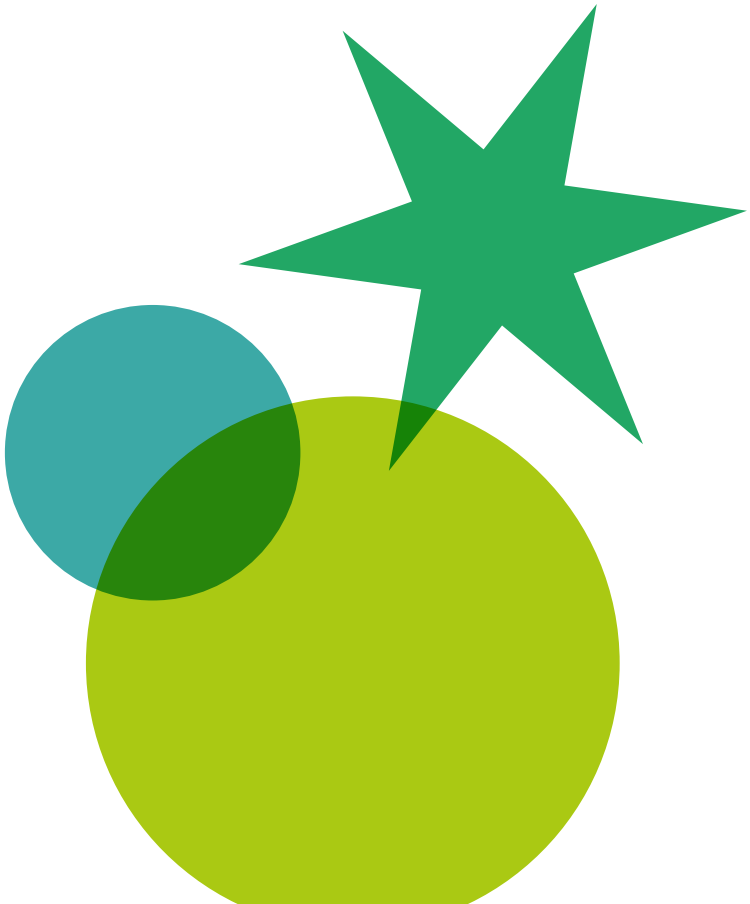
Representing. Children may represent their understanding of shapes in a variety of ways. For example, children might incorporate 2-D shapes into a drawing or painting or work together to define a shape by lying on the floor and using their bodies as the boundaries of shapes (i.e., three children form a triangle). A variety of art materials can be used to form the boundaries (e.g., yarn, pipe cleaners, wikki sticks). Geo-boards and rubber bands provide many opportunities for children to represent shapes with straight sides. The more experiences children have with representing shapes in a variety of ways and with a variety of materials, the more likely it is that they will develop a firm understanding of them.

Engaging young children in five important mathematical processes helps them develop and communicate their thinking about all areas of mathematics, including geometry

Problem solving. "Problem solving and reasoning are the heart of mathematics" (NAEYC, 2010). Young children learn by engaging with and solving meaningful problems in their everyday environments. A major way young children learn to identify and differentiate objects in their natural environment is by associating and attaching names to shapes. Early educators can plan developmentally appropriate opportunities for young children to solve mathematical problems and explore shapes through individual and small group activities that challenge current levels of understanding. For example, a teacher might invite a 2-year-old to point to a circle, while a more developmentally appropriate challenge for a 5-year-old might be to construct a hexagon. Teachers can support children's growing ability to solve problems of shape by posing questions that stretch their thinking (e.g., "Do you think you could make a hexagon on your geoboard? Can you show me? What if it had eight sides?"). Meaningful questions help children solve problems related to their everyday world. Teachers who wonder out loud model the disposition to be curious and to apply new knowledge in problem solving about 2-D shapes (e.g., "Wow! The shape of this door looks familiar. I wonder what shape it is.")

Reasoning and proof. Teachers can challenge preschool children's reasoning by conversing with them about their work with 2-D shapes and asking them to explain the decisions they make as they work with shapes (e.g., "How do you know that is a square and not a rectangle?" "What makes you think that these three shapes are all parallelograms?"). Asking children to justify their rules for grouping shapes into certain categories can help children practice identifying the salient features of 2-D shapes. This can be particularly useful in helping children to correctly identify shapes that are often misperceived by young children, such as a triangle with sides of unequal length or a square that is tilted 90 degrees. Learning to recognize patterns and regularities in shapes prepares children for more advanced math learning in the future.

Young children are better able to explore and reason about shapes when they work with models that they can manipulate. These might be shapes from a commercially produced set of attribute blocks or teacher-made shapes developed for a flannel-board. Preschool children cannot experiment with grouping and regrouping or changing the orientation of 2-D shapes that are printed on a worksheet. The use of worksheets is best reserved for children who have reached the stage of concrete operations (i.e., children ages 7 or 8).



Connecting. At the preschool level teachers can help children to see the relationship of 2-D shapes to their everyday world (see video clip 1). Teachers can assist children in making explicit connections between earlier levels of understanding and more advanced concepts (e.g., a triangle is still a triangle when its orientation in space is altered). They can help children link their thinking about shapes to other areas of math, such as number sense (e.g., "How will we know what shape this one is? I know, let's count the sides!"), as well as creating links between other disciplines and shapes (e.g., "some people live in homes that are shaped like a circle.")

Communicating. Encouraging children to communicate their thinking by verbalizing, drawing, writing, gesturing, and using concrete objects or symbols can help them share their ideas about shapes with other children and adults. As children learn the names of the shapes and their parts (e.g., side, angle, vertex) they are better able to communicate about them. Helping children expand and use a rich vocabulary related to shapes also supports their ability to communicate their thinking with others (e.g., "the pointy one," the long one," "the narrow one," "the wide one"). Modeling and encouraging children to use informal and formal math terms to describe their thinking about 2-D shapes in their everyday world will help to "mathematize" their world.

Strategies for Supporting Dual Language Learners

Several strategies can be used to help Dual Language Learners (DLLs) learn 2-dimensional shapes. First, it is important that a teacher becomes familiar with a child's home culture. This might be accomplished through home visits and/or interviews with the child and his or her primary caregivers. The teacher can use this knowledge as she engages in informal conversations with the child to refer to familiar objects that exemplify shapes (i.e., a tortilla is circular). In addition, some languages, such as Spanish, use shape words with the same cognate or linguistic root. Words like this are similar enough that the teacher can help young DLLs bridge the label for a particular shape by labeling the shape in both languages (e.g., *triangle*, *triángulo*). Gestures or drawings can be used effectively to communicate about 2-dimensional shapes. For example, the teacher can draw a triangle with his fingers and say, *triangle*, *triángulo*. He can encourage the DLL to engage in a charades-like game, in which the he and the child take turns guessing which shape their partner is forming. Since the ability to recognize a shape precedes the ability to label one, games in which DLLs are asked to identify should precede those in which the child is asked to verbally label something. Books that incorporate shapes are available in both English and the DLL's home language can be read repetitively to reinforce the name of shapes and related concepts (e.g., a triangle has three sides). Finally, pictorial representations of shapes can be displayed around the room and can be referenced by the DLL, peers, and teachers. Labeling the shapes in the home languages of all DLLs in the class can help remind the teacher to verbally name the shape in the child's home and school languages. For further information, see the microteach guide, *Supporting Mathematical Learning of Young Dual Language Learners* (Beneke, 2016).

Table 2. Examples of teacher language that supports children's mathematical processes* with shapes

Representing
How would that look?
What could we use to make a _____ ?
Let's take turns making triangles!
How many different kinds of triangles can you make?
How can we use these pipe cleaners and straws to make rectangles?
Problem-Solving
Can you show me a _____ (e.g., triangle, rhombus, rectangle)?
What shape is the face of this block?
What would we call a shape if it had _____ sides?
I wonder how we could find out the name of this shape?
What shape is this table?
Reasoning & Proof
How do you know this is a rhombus and not a rectangle?
What makes you think that these three shapes are all triangles?
Why isn't this a square?
How can I check to see if this is a pentagon?
Why did you sort the shapes this way? Is there another way to sort them?
Can you figure out my rule for sorting shapes? How do you know that's the rule?
Connecting
This is a square, because it has four equal straight sides and four right angles. If I turn it, so the corner is down, does the shape change?
The face of this block is a rectangle. Can you find other things in our room that are rectangles?
Let's go on a shape hunt! Can you find shapes with right angles in our room?
Let's look at this book about the fair. The ferris wheel is like a big circle! Do you see any other shapes?
Communicating
How are these rectangles different from one another?
Look at this one. It's really _____ (e.g., wide, long, narrow, tiny)!
The two sides of the rectangle come together at the _____ (i.e., vertex).
When the corner of a shape is pointy, the angle is _____ (i.e., narrow).
Would you call this a kite or a rhombus? How can you tell?

**Mathematical processes described by the National Research Council (2009)*

Table 3. Examples of useful materials for teaching and learning about 2-D shapes in preschool

Blocks
Unit blocks
Attribute blocks
Pattern blocks (including trapezoids, squares, triangles, hexagons, rhombi)
Table Toys
Tangrams
Geoboards
Assorted shape manipulatives
Feely box
Puzzles
Knob puzzles with non-connecting pieces (4 – 26 pieces)
Foam insert puzzles with non-connecting pieces
Simple foam or wood framed puzzles with connecting pieces (4 – 9 pieces)
More complex framed foam or wood puzzles with connecting (7 - 35 pieces)
Jigsaw (i.e., interlocking) wooden puzzles (4 – 48 pieces)
Floor puzzles
Boards
Flannel-board with shape pieces
Board games that focus on shapes
Magnetic-board with shape pieces
Books
Bear in a Square by Stella Blackstone and Debbie Harter
Mouse Shapes by Ellen Walsh
Perfect Square by Michael Hall
Shape by Shape by Suse MacDonald
Shapes, Shapes, Shapes by Tana Hoban
Ship Shapes by Stella Blackstone
The Dot by Peter Reynolds
The Greedy Traingle by Marilyn Burns
The Village of Round and Square Houses, by Ana Grifalconi
When a Line Bends... A Shape Begins by Rhonda Greene

Instructions for Doing the Microteach

1. This microteach is to take place with a group of at least 3 children, ideally of diverse abilities.

2. Assess the children in advance to determine what step they are on, on the pathway for mastery of 2-D shapes (see Table 1).

3. Select one mathematical process you will emphasize in your lesson (i.e., communicating, connecting, reasoning and proof, problem-solving, or representing).

4. Use the *Lesson Plan Template* to plan a lesson on 2-D shapes that will support the learning of the children you will be teaching. Consider how you will individualize for the children in your small group.

5. Videotape yourself implementing the lesson with the children.

6. Follow the *Procedure for Microteach* handout.

References

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