CHAPTER 6

KDI 34. Shapes
E. Mathematics

34. Shapes: Children identify, name, and describe shapes.

**Description:** Children recognize, compare, and sort two- and three-dimensional shapes (e.g., triangle, rectangle, circle; cone, cube, sphere). They understand what makes a shape a shape (e.g., all triangles have three sides and three points). Children transform (change) shapes by putting things together and taking them apart.

At small-group time, the teacher covers a shape with a scarf and asks David to guess what it is. He runs his fingers along the sides of the hidden shape and says, “It’s a rectangle.”

At snacktime, while eating cheese crackers, Senguele holds one up and says, “A diamond has four sides, a square has four sides. A circle doesn’t have sides. It’s round and round.”

At small-group time, Matthew uses two triangular Magna-Tiles to make “a diamond.”

At work time in the toy area, Joey rolls the tape on the table and says, “This is like a wheel because it’s a circle.”

Young children enjoy working with shapes. They handle them, for example, when they complete puzzles, and spontaneously sort shapes, for example, when they put squares in one pile and triangles in another. Preschoolers also combine and transform shapes to make other shapes. During these explorations, they often create their own shapes. Through these repeated hands-on interactions, preschoolers begin to recognize and name two-dimensional shapes (such as rectangle and circle) and three-dimensional shapes (such as cube and cylinder). They identify the characteristics of shapes (e.g., triangles have three sides and three angles). Young children also explore what happens when they combine (compose) and take apart (decompose) shapes to make new shapes.

**The Importance of Shapes**

Shape refers to the outline, contour, or form of objects. The young child’s exploration of shape, together with emerging spatial awareness (key developmental indicator [KDI] 35), are the foundation for studying geometry. Along with number (KDIs 31–33) and measurement (KDIs 36–37), geometry is one of the three focal points identified by the National Council of Teachers of Mathematics (NCTM) as being critical to developing mathematical understanding in the preschool years. Beyond its importance in mathematics, knowing shapes serves a more general cognitive purpose. Since shape is a basic feature of the physical world, being aware of shape helps children learn the names of many things along with their attributes and functions (Jones & Smith, 2002).
Preschoolers learn about the many properties of shapes during their everyday experiences. For example, they learn that shapes may be regular or irregular; that they come in two- and three-dimensional forms; and that they have names, such as circle, triangle, rectangle, and square (an equal-sided rectangle):

Lying on her back at naptime, Abby counts the corners of the room. “Hmmm,” she muses, “four corners. It must be a square.” “How many corners does a circle have?” whispers Robert, lying next to her. Abby answers, “One, right in the middle.” “Right in the middle,” Robert agrees. Sheldon, on the other side of Abby, disagrees. “Circles don’t have corners,” he says.

Preschoolers discover the features that make a shape a shape, such as whether it is curved or straight sided and the number of angles it has. They transform or change shapes by combining them to make new structures and by moving them in various ways (sliding them into different positions, rotating or turning them, or flipping them over from front to back). They also explore symmetry; that is, whether or not shapes are the same on both sides when they are divided along a horizontal or vertical axis:

At work time in the house area, Bonita puts a shirt on her doll and explains to Yael, “First you do this arm and then you do this arm. See, it’s the same on both sides.” Yael imitates her to dress her doll. “That’s right,” says Bonita, “one side and then the other side.”

As with other areas of mathematical development, preschoolers begin their investigation of shape by working with concrete materials. They hold shapes in their hands and turn them in various ways. They see and identify shapes in their environment. Later, as children are able to create mental representations of shapes in their minds, they can imagine what they look like.

At work time in the art area, Samson folds a piece of paper in half, opens it up, and flattens it on the table. He runs his finger down the crease and says in amazement, “I made it the same on both sides!”

“How can I fit inside this tire?” This young child learns about the properties of circles through her everyday experiences on the playground.
like and what will happen if they undergo a transformation. For example, a younger child will physically turn the pieces of a jigsaw puzzle in the opening until it slips into place. An older child will look at the opening, pick a shape with the corresponding outline, turn it in the air, and set it in place.

How Knowledge About Shapes Develops

An awareness of shapes emerges early in cognitive development (Clements, 2004a). Children seem to have an innate ability to recognize and match shapes and do so instinctively in their play, even before they know shape names. The ability to differentiate between two- and three-dimensional shapes also appears to be intuitive. For example, young children match squares with squares and cubes with cubes rather than with one another. However, very young children are not at first able to consistently differentiate one shape from another, such as triangles from rectangles or rectangles from other four-sided shapes (National Research Council, 2009). Somewhat later, children do form general categories for shapes, but they relate them to their own experiences rather than to identifiable or distinctive properties. For example, they say a figure is a rectangle “because it looks like a door” or something is a circle “because it’s like a clock” (Sarama & Clements, 2009).

The next step in development is when young children begin to analyze and describe the shapes themselves. Initially they learn about the parts of a shape (sides, edges; angles, points) and how they connect to form the closed “whole” of a particular shape (a triangle has three sides and three angles). Their emerging knowledge about number helps them focus on these defining attributes:

At outside time, James runs his hands up the side of the swing frame. He says, “Wow, this is a giant triangle!” Dionne, his teacher asks, “How can you tell?” James replies, “See, it’s got two long parts that go up to a point, and the ground is the bottom.”

Finally, children create an overall understanding of a shape and its parts and how the unique properties of each shape differentiate it from all other shapes. By the end of preschool, the vast majority of children can accurately name two-dimensional shapes such as circle and square, and to a slightly lesser extent, triangle and rectangle (Clements, Swaminathan, Hannibal, & Sarama, 1999):

At small-group time, Joshua explains his Magna-Tile construction to the teacher. “It’s a house,” he says, “a triangle and a rectangle. It [he points to the triangle] has three sides and it [he points to the rectangle] has four sides.”

Children can accurately name a shape even when it varies in size or orientation; for example, they recognize a triangle no matter which one of its sides it rests on. Many also know the names of common three-dimensional shapes (ball or sphere, box or cube, cylinder) and several additional two-dimensional shapes, such as diamond and even parallelogram.

The ability to accurately name, describe, and compare shapes is an important achievement during the preschool years. It reflects the child’s growing observational skills and emerging interest in classifying things based on physical attributes. Equally significant is learning how to transform shapes to bring about a desired result (“I’m making this bridge longer by adding a square block at each end and one in the middle to hold it up”). Imagining, carrying out, and describing transformations are meaningful
indicators of children’s representational abilities and critical-thinking skills. Language is a vital component in all these descriptive and problem-solving activities. Thus, as the child’s ability to describe shapes and changes in shape expands, so does his or her geometric understanding.

Teaching Strategies That Support Naming and Using Shapes

As described under “General Teaching Strategies” in chapter 2, children need to work directly and concretely with shapes. They also need to hear shape names and other vocabulary words associated with the properties of shapes and their transformation. To implement these and other shape-specific teaching strategies, adults can engage children in the following ways.

Provide shapes for children to see and touch

Looking at and physically manipulating shapes helps young children learn about their essential attributes. In the same way a print-rich environment exposes children to the properties of letters, so too does a shape-rich environment acquaint them with the attributes and relationships of shapes. To help preschoolers identify, describe, and compare shapes, use the following ideas.

Add two- and three-dimensional shapes to the classroom

Provide opportunities for children to explore two- and three dimensional shapes in a variety of sturdy materials, such as shape puzzles, shape boxes, wooden blocks, heavy cardboard, Styrofoam, fabric, and wooden spools:

Encourage children to feel, touch, and explore three-dimensional shapes and include more unusual shapes as well, such as cylinders and arches.
At work time in the block area, Bing walks around a circle he has made on the floor using wooden spools. “Hey,” he says, “we could listen to ‘Wheels on the Bus’ because they go round and round.”

Encourage children to run their fingers around the shapes to become familiar with their contours (curves, the number and relative length of the sides, the number and width of the angles). Make sure children encounter many examples of each type of shape so they learn to generalize its properties (e.g., include triangles in different sizes and materials and with equal and unequal angles):

At small-group time, while holding a wooden circle, Cara says, “A circle doesn’t have any sides; it only has circles.” Then she picks up a triangle and says, “It has three sides.”

Be sure to include arches and circles as well as triangles, rectangles, and squares in sets of building materials. Also include irregular shapes, and vary the texture so children are drawn to feel as well as see the shapes.

Encourage children to sort shapes and provide reasons for their groupings

Ask children to describe why shapes are not alike (how triangles differ from rectangles or how rectangles differ from squares). Encourage them to explain why something is not a particular shape (if it only has three points, it can’t be a square; if it has three sides but one side is curved, it’s not a triangle). Talking about shapes in these ways helps children understand what makes a shape a shape:

At small-group time, Imogen sorts “all the same squares” (actual squares) into one basket and “all the different squares” (rectangles) into another basket.

Encourage children to explore less common shapes

Children enjoy hearing and learning names such as cylinder, trapezoid, parallelogram, and octagon. Even if preschoolers do not immediately grasp their meaning and distinctive characteristics, they become attuned to the variety and functions of shapes in the world.

Provide materials with vertical symmetry and horizontal symmetry

Doll clothes, teeter-totters, and toy airplanes are common preschool materials that have vertical symmetry (left-right halves are identical) and/or horizontal symmetry (top-bottom halves are identical). For contrast, provide similar but asymmetric materials such as a glove, slide, and toy crane. Engage children in discussing how the two sides (or top and bottom) of objects are the same (symmetrical) or different (asymmetrical). Point out symmetry in the things children build or draw. For example, children often paint one side of a picture and then paint the same thing on the other side, such as a blue line down one side and a blue line down the other.
Use printed materials to focus on shape
Cut out photographs from magazines that feature shapes and encourage children to sort them. Create a shape scrapbook for the book area.

Encourage children to create and transform shapes and observe and describe the results
Young children naturally transform materials during play, observe and comment on the result, and may attempt to describe and explain the change. These transformations typically happen during constructive play (building structures) and often involve shapes (Chalufour & Worth, 2003). Typical examples are putting together two square blocks to make a rectangle or flattening a ball of clay into a circle. To build on children’s spontaneous explorations as they transform shapes, and to encourage them to reflect on the changes they observe, use the following ideas.

Provide materials children can use to create and modify shapes
Children enjoy working with Popsicle sticks, toothpicks, marshmallows or gumdrops (or small balls of clay or play dough in place of food), and pieces of yarn. They can bend pipe cleaners into bubble wands and predict what shape bubble will emerge. As they assemble, take apart, and rearrange the materials, talk with children during this small-group time, the teacher provides the children with pretzel sticks and marshmallows. She encourages the children to explore what shapes they can make with those materials.
about what defines the shapes they make. At large-group time, see if they can form their bodies into shapes and move to transform them:

At large-group time, Samantha lies straight on the floor with her arms pressed against her sides. “I’m a rectangle,” she announces. Jonah curls into a ball and says he’s a circle.

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At snacktime, Christian breaks his square graham cracker in half and says, “Two rectangles.”

Talk with children as they create new shapes
As children combine and take apart shapes to create new shapes, encourage them to say what is the same and/or different after each change. Explore how shapes may be combined or divided to make other recognizable shapes; for example, two squares make a rectangle, a diamond splits into two triangles, two right triangles of the same size make a square or a rectangle, a circle cut in half makes two moon shapes or half circles.

Look for computer programs that allow children to manipulate shapes
Computers can be helpful as children explore transforming shapes because they are more flexible and agile than young children’s hands (Clements, 1999). Appropriate programs allow children to slide, rotate, and flip shapes with relative ease and then observe the results. While computers should never replace manipulatives in the classroom, they can be a useful addition when young children want to draw, alter, and combine shapes:

At work time at the computer, Ramone advises Keisha to find the long squares, and then be will find the short squares while they play together on the shape-sorting game.

Name shapes and the actions children use to transform them
Labels help children identify shapes and the actions they perform with them; in addition, having the appropriate language at their disposal actually increases preschoolers’ powers of observation and explanation (Greenes, 1999). To provide children with the words for shape names and attributes, as well as the process and outcomes of transformation, you can do the following:

Identify and label shapes throughout the environment
Apply the games you use to find letters and numerals to shapes. For example, go on a shape hunt in the classroom or on a walk. Begin with a single shape (a search for triangles) and later give children two or more shapes to find. Other options include playing shape I spy (e.g., “I see something shaped like a rectangle in the house area. What do you think it is?”) or using shapes at cleanup time (e.g., “Let’s put away everything shaped like a circle”). While discussing shapes with children, begin with simple labels (“On our walk, let’s look for all the square signs”) and gradually introduce more sophisticated ones (“You built your dollhouse with cubes”; “The shape of the stop sign is called an octagon”). Remember to supply the names of three-dimensional as well as two-dimensional shapes:

At small-group time, after Emily (a teacher) explains that the shape Matthew has is a sphere, Tasha holds one up and says, “I have a sphere.” When Emily labels the shape in Ella’s hand a cylinder, David finds one in his basket and says, “I have a cylinder.”

Label, describe, and discuss shape attributes
Children may use different shape words, so repeat theirs and add others. For example, refer to sides and edges as well as points, angles, and
corners. Discuss the difference between straight and curved lines. The more words children have, the more aware they become of what makes a shape a shape:

*At work time in the toy area, when Barney asks Dov how to make a rocket ship out of Magna-Tiles, Dov says, “You need a triangle: three sides and three points.”*

**Describe and encourage children to describe their actions and outcomes as they transform shapes**

While children enjoy transforming materials as they build or do artwork, they typically do not reflect on the changes unless adults intentionally encourage them to do so. When talking about transformations with children, emphasize the shape they start with and the one they end up

As this young child makes a pattern with the circles and rectangles, he recognizes that rectangles have straight sides while circles have curved lines.
with (“You put two squares together and made a rectangle”). Provide labels for children’s motions with shapes, such as sliding, turning, and flipping. Some children may be intrigued to learn more sophisticated verbs as well, such as *rotating* and *reversing*.

For examples of how children at different stages of development demonstrate their growing understanding of the names, properties, and transformation of shapes, and how adults can scaffold their learning in this KDI, see “Ideas for Scaffolding KDI 34. Shapes” on page 69. The ideas suggested in the chart will help you support and gently extend children’s understanding of shapes as you play and interact with them in other ways throughout the daily routine.

*Open-ended materials (such as Magna-Tiles) encourage children to create and transform shapes.*
Ideas for Scaffolding KDI 34. Shapes

Always support children at their current level and occasionally offer a gentle extension.

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**Children may**
- Manipulate shapes in play.
- Match some shapes as they play without identifying their individual attributes.
- Work with shapes individually (e.g., use a circle as a “sun”); physically turn puzzle pieces until they slip into place.

**Children may**
- Recognize and name basic shapes (i.e., circle, triangle, square); use the same label for similar shapes (e.g., call a rectangle a square).
- Identify a few shape attributes (e.g., refer to a shape’s side or corner).
- Select shapes based on their properties to make something else (e.g., put a triangle on top of a square and say they made a house).

**Children may**
- Identify two-dimensional shapes (e.g., rectangle, diamond, oval) and some three-dimensional shapes (e.g., cone, cube, pyramid).
- Know what makes a shape a shape regardless of size or orientation (e.g., “These are both triangles. They both have three sides. This one is just longer”).
- Combine or recombine shapes to make another specific shape (e.g., use two triangles because they want or need to make a square).

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<td>• Provide two-dimensional materials in basic shapes (i.e., circle, triangle, square).</td>
<td>• Acknowledge the shapes children know and use them in conversation.</td>
<td>• Provide two- and three-dimensional materials in a wide variety of shapes.</td>
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<td>• Match shapes alongside children; comment that they are the same shape.</td>
<td>• Affirm when children identify an attribute of a shape (e.g., “Yes, your square does have four sides”).</td>
<td>• Encourage children to describe other attributes of the shapes they name (e.g., “It does have three sides. What else makes it a triangle?”).</td>
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<td>• Comment on how children manipulate shapes (e.g., “You flipped the circle over”; “You turned the triangle piece so it fit”).</td>
<td>• Comment on the things children make when they combine shapes (e.g., “You made a person with a rectangle and a circle”).</td>
<td>• Comment on the new shapes children make (e.g., “You made a rectangle with those two squares”).</td>
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<td>• Name basic shapes as they play with children (e.g., “I’m stacking the triangle blocks”).</td>
<td>• Introduce the names of other shapes (e.g., rectangle, cube).</td>
<td>• Point out the similarities between shapes and common objects in the environment (e.g., “The tabletop is a rectangle”).</td>
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<td>• Comment on the attributes of shapes (e.g., “I’m looking for a triangle. It has three sides”).</td>
<td>• Comment on what makes a shape a shape (e.g., “A triangle does have three sides. It also has three points”).</td>
<td>• Ask how children know that all of a certain shape is that shape (e.g., “What makes all of these squares?”).</td>
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<td>• Model how shapes can be manipulated or combined to make something else (e.g., “Look what happened when I put my circle on my triangle. It looks like an ice cream cone!”).</td>
<td>• Comment when children combine shapes and make different shapes (e.g., “You did make a kite. Those two triangles also make a diamond shape”).</td>
<td>• Ask what shapes children used to make another shape (e.g., “What shapes did you use to make that rectangle?”).</td>
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