COMMON MISCONCEPTIONS

• A shape can fit into only one discrete category.

Students may believe that there is only one correct category for a shape. Visual representations of the different quadrilateral categories and hierarchy of subcategories can help students see how a shape fits into not only its most specific category (square) but categories for which it is a subcategory (a square is a type of rectangle, rhombus, parallelogram, and quadrilateral). You can also use real-world examples of categories to keep students engaged and help them make sense of hierarchies. For example, a chocolate Labrador is also a brown dog, a Labrador, and a dog.

• Size and orientation of a shape is a defining attribute.

Size and orientation are irrelevant to the classification of shapes. Have students practice both classifying similar shapes (such as sorting different sizes of squares into the category square) and sorting shapes that are rotated versions of each other into the same category.

• A square is a rectangle; therefore, a rectangle is a square.

A rectangle (a quadrilateral with four right angles) that has all four sides of equal side lengths is a square, but one whose two sets of opposite sides are equal to each other is not a square. List the attributes of a rectangle and the attributes of a square. Point out to students that there is one more defining feature of squares (all sides the same length). Note that there are lots of rectangles where the sides aren’t the same length. Help students to see that each time we add a new attribute, fewer polygons belong to the group.

ATTRIBUTES OF QUADRILATERALS

Students have learned much of the vocabulary used in today’s lesson in prior grade levels, but not all. New vocabulary may include parallel, right angle, parallelogram, and quadrilateral. Start this lesson by directing students to recall from second grade that closed shapes that have no gaps or overlaps between the straight sides are called **polygons** and that polygons with four straight sides are called **quadrilaterals**. Explain that two sides of a shape are **parallel** if they stay the same distance from each other and never cross. Quadrilaterals that have exactly one set of parallel sides are **trapezoids** and four-sided polygons that have two sets of parallel sides are **parallelograms**. Explain that a square corner is called a **right angle**. Quadrilaterals that have four right angles are called **rectangles**. **Squares** are shapes that have four right angles and four equal sides. The name for a shape with four equal sides is a **rhombus**. Finally, a **kite** is a quadrilateral with no parallel sides and two pairs of sides of equal length next to each other.
Next, students extend this knowledge of individual types of shapes’ attributes and learn that different shapes (squares, rectangles, and rhombuses) have shared attributes that can fall within a larger category (parallelograms, quadrilaterals, and trapezoids). For example, the category of shapes called quadrilaterals includes categories such as squares, rectangles, rhombuses, parallelograms, and trapezoids, since they are all closed shapes with four sides. Squares, rectangles, and rhombuses have the shared attribute of two sets of parallel opposite sides and therefore all fit into the category of parallelogram. Squares have four right angles and fall into the category rectangle (a quadrilateral with four right angles). Squares also fall into the category of rhombus (a quadrilateral with four sides of equal length).

By focusing on a class of shapes, students are able to think about what makes a rectangle a rectangle (four sides, opposite sides parallel, opposite sides same length, four right angles). They can use these attributes to see that all squares (four equal sides, opposite sides parallel, opposite sides same length, four right angles) are rectangles but not all rectangles are squares. Each time we add a new attribute, fewer polygons belong to the group. Students also learn that for a shape to fit into a category, the shape needs to have all of the attributes that define that category, not just one or several attributes. As students learn which attributes are shared, the process of comparing shapes also leads to discussion about the differences between shapes.

In this lesson, students not only learn to classify quadrilaterals according to attributes such as the presence of parallel sides, the presence of right angles, and the presence of equal side lengths, but they also learn to justify those classifications.

In Grade 2, students learned to name and describe the defining attributes of categories of two-dimensional shapes, including circles, triangles, squares, rectangles, rhombuses, trapezoids, and the general category of quadrilateral. In Grade 3, students use this understanding to further explore quadrilaterals.

Questioning techniques play an important role in students’ ability to learn to properly classify quadrilaterals. Allow students to justify their reasoning for sorting shapes into certain categories by questioning their sorting strategies. Question students to see whether observations made about a particular shape apply to other similar shapes.

Give students plenty of opportunities to work with physical representations of quadrilaterals, using cut outs or manipulatives.

Students may become confused by the term “grouping” as used to classify quadrilaterals with shared attributes. They may think of grouping as bundling units that are exactly the same, as in regrouping for addition or subtraction. Stress that grouping here means sorting polygons by one or more shared attributes.