

NEWSLETTER

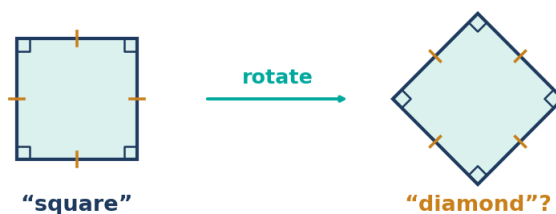
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A SQUARE IS A RECTANGLE?

Teaching Quadrilaterals Through Properties and Relationships

A student labels a rotated square a “diamond.” Another insists that a square cannot be a rectangle because “rectangles are the long ones.”



These responses tell us something important about how students are classifying shapes. They are reasoning from what the shapes look like rather than from the properties that define them.

When instruction presents shapes as pictures to recognize rather than as figures defined by properties, students’ classifications break down when a familiar shape is rotated, stretched, or shown in an unfamiliar form.

DMT Insight 46, Teaching Quadrilaterals for Understanding, explains why these misconceptions persist and what they mean for instruction.

When Appearance Becomes the Rule

Students often see quadrilaterals presented like this:

- Posters and flash cards showing one “standard” example of each shape
- Worksheets where every parallelogram leans the same direction
- Shape names treated as mutually exclusive labels
- Squares and rectangles presented as separate, non-overlapping categories

From a student’s perspective, geometry becomes recognizing what shapes look like, not reasoning about what must be true.

Students then apply what the examples have shown them:

- “A square is a square. It can’t also be a rectangle.”
- “That tilted shape is a diamond. It doesn’t look like a square.”

- “I know it’s a parallelogram because it looks like the one in the book.”
- “A trapezoid always looks like a pattern block.”

When students repeatedly see only prototypical examples, appearance can become part of what they think defines the shape.

When Familiar Examples Become the Rule

Research helps explain why students may continue to classify shapes this way. Two ideas are useful: prototypes and the difference between a concept image and a concept definition.

The first is the prototype. When students repeatedly see the same example, such as a wide, horizontal rectangle, an upright square, or a parallelogram that leans to one side, they begin to associate that example with the category and use it to decide what belongs. They reject a shape that does not match the example, regardless of its properties.

The second is the gap between the concept image and the concept definition. A student may recite “a rectangle has four right angles” while the student’s concept image still excludes squares and tall, narrow rectangles. A student may state the definition and still rely on appearance when classifying a shape.

Students need examples that vary in orientation, size, and dimensions so they can distinguish defining properties from features that can change.

Ask What Must Be True

Give students opportunities to investigate line segments, angles, parallel relationships, and perpendicular relationships as they develop and use shape definitions.

Students can then reason from the properties and relationships:

- Congruent sides have the same length
- Parallel sides lie on lines that never meet, no matter how far they are extended
- A right angle is formed by perpendicular sides, not by whether a corner “looks square”
- A quadrilateral category is defined by its properties, not by which picture a shape resembles

When instruction consistently asks, “What must be true about this shape, no matter how it is oriented?” students begin to classify from properties rather than appearance.

Questions to ask during instruction:

- “What relationships do you notice among the sides?”
- “How do you know those sides are parallel?”
- “What would have to change for this rhombus to become a square?”
- “What changed? What stayed the same?”
- “Which properties must always be true?”
- “Could this shape belong to more than one category? How do you know?”

These questions move students from recognizing quadrilaterals to reasoning about them.

Why a Square Is Also a Rectangle

Many students treat category names as mutually exclusive. A square is one thing and a rectangle is another, so a square cannot be a rectangle.

The definitions show how the categories are related:

- Parallelogram: a quadrilateral with two pairs of parallel sides
- Rectangle: a parallelogram with four right angles
- Rhombus: a parallelogram with four congruent sides
- Square: a parallelogram with four right angles and four congruent sides

A square satisfies all of the defining properties of a rectangle and has additional properties. That is why every square is also a rectangle. A nested diagram can make these relationships visible: squares are inside rectangles, rectangles are inside parallelograms, and parallelograms are inside trapezoids when trapezoid is defined as a quadrilateral with at least one pair of parallel sides.

Your Turn to Share

What quadrilateral misconception do you see each year? What question helps students reconsider the idea? Share it with us at contact@dmtinstitute.com.

Keep developing mathematical thinkers.

More Information

This is a quick overview. To download DMT Insight 46 and the Companion, go to DMT Insights at mathsuccess.io/dmtinsights.

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