Quadrilaterals

Summary

Students will create, classify and sort quadrilaterals.

Group Size

Individual

Materials

Geoboards and geobands
- Geodot Paper (pdf)

Various quadrilateral shapes
- Quadrilateral Family Tree (pdf)
- Quadrilateral Pieces (pdf)
- Quadrilateral Venn Diagram (pdf)

Yarn or string

Additional Resources
- *Navigating Through Geometry in Grades 3-5*, edited by M. Katherine Gavin and Gilbert J. Cuevas (NCTM Publication); ISBN 0-87353-512-X

Background for Teachers

A common activity involving geometry is for students to recognize and name various polygons. Their experiences with four-sided polygons may lack depth or may have some misconceptions. For example, students are often taught to categorize rectangles and squares separately. Typically, a polygon with four equal sides and four equal angles is referred to as a square; whereas, a polygon with four equal angles but one pair of long sides and one pair of short sides is referred to as a rectangle. We hear students refer to rectangles as being "long" or "tall." Their system for differentiating between squares and rectangles is based on narrow experiences with a few specific examples.

These constructions may cause confusion later as students learn that squares also fit the description of rectangles. This new information does not fit logically to what they have already learned, and it does not allow for growth in understanding that a square is a more specific classification of a rectangle; just as a rectangle is a more specific classification of a parallelogram; and that a parallelogram is a specific classification of a quadrilateral. These shapes all fit in the quadrilateral "family."

To aid understanding, teach quadrilaterals as a whole. Define quadrilaterals as a four-sided figure and give students the opportunity to create a variety of quadrilaterals. They look for similarities and differences and sort them into several different categories according to their attributes. The sorting activity offers insight into the mathematical hierarchy used in classifying quadrilaterals. It will become clear that every quadrilateral falls into three categories:

those with two pairs of parallel sides,
those with only one pair of parallel sides, and
those with no parallel sides.

This activity will set the stage for students to understand that many types of quadrilaterals exist and that these shapes have some elements in common.

Intended Learning Outcomes

1. Demonstrate a positive learning attitude toward mathematics.
3. Reason mathematically.
4. Communicate mathematically.
5. Make mathematical connections.

Instructional Procedures

Invitation to Learn

Provide each student with a geoboard and geoband. Ask them to create several four-sided polygons, then choose their most unique quadrilateral to share with their group.

Instructional Procedures

Ask the students to compare their quadrilateral with those made by other members in their group. Are all quadrilaterals different? If not, agree on how to make them look different. Record quadrilateral on *Geodot Paper* and cut shape out for display.

Invite each group to post their quadrilaterals in one of three columns:

those with one pair of parallel sides,
those with two pairs of parallel sides, and
those with no parallel sides.

Give students time to determine if all the quadrilaterals are in their appropriate columns. Discuss congruent and similar shapes and remove any duplicates.

Identify the columns with the appropriate headings: *trapezoids* (one pair of parallel sides), *parallelograms* (two pair of parallel sides), and *trapeziums* (no parallel sides).

Use the *Quadrilateral Family Tree* handout to discuss the properties, attributes, and characteristics, as well as the interconnective and hierarchical commonalities and differences, between and among quadrilateral shapes.

Have the students look at the relationship between squares and rectangles. What are the characteristics of each? Is a square a rectangle? (Yes, it has four equal angles.) Are all rectangles squares? (No, many rectangles do not have four equal angles and four equal sides.)

Have the students look at the relationship between squares and rhombuses. What are the characteristics of each? Is a square a rhombus? (Yes, it has four equal sides.) Are all rhombuses squares? (No, many rhombuses do not have four equal sides and four equal angles.)

A Venn Diagram is a good visual aid to illustrate that a square is both a rectangle and a rhombus.

Further explore the relationships between quadrilaterals by having the students work with roping quadrilaterals. Provide each pair of students a set *Quadrilateral Pieces* and two or three pieces of string to make a *Quadrilateral Venn Diagram.* Ask them to place the appropriate quadrilateral pieces in each ring according to the following labels:

Ring 1 (Left side): At least one pair of parallel sides
Ring 2 (Right side) No sides parallel

Ask students to justify their placement of different pieces. What do all the shapes in one ring have in common? How might the shapes in one ring be different? (Some shapes in Ring 1 are trapezoids, and some are parallelograms.) What different label would eliminate one or more of the shapes from a ring? (Only one pair of parallel sides.) If we drew a giant circle around everything, including any shapes that are outside the rings, what might the label for this new ring be? (Quadrilaterals) Try further explorations using the following labels:

Ring 1 (Inner ring): All sides of equal length
Ring 2 (Outer ring): At least one pair of parallel sides

Ring 1 (Left side): At least one right angle
Ring 2 (Right side): No right angles

Ring 1 (Left side): All sides the same length
Ring 2 (Right side): At least one acute angle

Ring 1 (Left side): At least one set of parallel sides
Ring 2 (Right side): At least one obtuse angle

Extensions

Have students make their own labels and then challenge a partner to use them to create quadrilateral rings.
Have students make “mystery rings” for their partner to solve. Simply sort quadrilaterals into the Venn Diagram rings according to some characteristic and have a partner try to decide how the quadrilateral pieces have been sorted.

Family Connections

Have students take home the quadrilateral pieces to share with their family. Show them how to sort the pieces in each ring according to the labels given. They may need to overlap some rings to form intersections. Make “mystery rings” for family members to solve.

Assessment Plan

Have students justify the placement of quadrilaterals in the Venn Diagram. Journal reflections explaining the placement of quadrilaterals are useful for checking students’ understanding.
Have students explain the relationship among the rectangle, rhombus, and square.

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