

Quadrilateral Construction

Strand: Polygons and Circles

Topic: Prove and justify theorems and properties of quadrilaterals

Primary SOL: **G.PC.1 The student will prove and justify theorems and properties of quadrilaterals, and verify and use properties of quadrilaterals to solve problems, including relationships between the sides, angles, and diagonals.**

d. Use congruent segment, congruent angle, angle bisector, perpendicular line, and/or parallel line constructions to verify properties of quadrilaterals.

Materials

- Dynamic geometry software package or compass, ruler, and paper
- Verifying Properties of Quadrilaterals activity sheet (attached)

Vocabulary

angle, bisector, congruent, diagonal, isosceles trapezoid, line, perpendicular, parallel, segment, parallelogram, quadrilateral, rectangle, regular polygon, rhombus, right angles, square, trapezoid

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Have students work individually graphing Quadrilateral ABCD and Quadrilateral RSTU using dynamic software or graph paper. Facilitate discussion asking student pairs to discuss and predict the specific type of quadrilateral graphed: parallelogram, rectangle, rhombus, square, or trapezoid.
2. The teacher may choose to have students focus on specific constructions for the activity.
3. Student pairs will use constructions to verify their predictions completing the activity sheet, Verifying Properties of Quadrilaterals.
 - a. Questions the teacher could ask student pairs during the activity include:
 - i. What quadrilaterals can you rule out based upon your graph and why?
 - ii. What would verification of opposite sides congruent mean for the category of quadrilateral?
 - iii. What would verification of congruent diagonals mean for the category of quadrilateral?
 - iv. What would verification of diagonals bisecting opposite angles mean for the category of the quadrilateral?
 - b. Ask students what other methods can be used to verify the following properties. Responses may include:
 - i. Congruent segments
 - ii. Parallel lines
 - iii. Congruent angles
 - iv. Bisected angles

Assessment

- **Questions**
 - When verifying quadrilateral properties, which constructions would you choose to use, and which constructions would you substitute with another method of verification?
 - Which constructions could be used to verify the properties of a trapezoid? An isosceles trapezoid?
 - How would you use constructions to classify triangles as scalene, isosceles, equilateral, right, acute, obtuse?
- **Journal/writing prompts**
 - What are other methods of verifying the properties of quadrilaterals in addition to constructions? What are the advantages and/or disadvantages of these methods?
- **Other Assessments**
 - List the constructions that would be used to verify the classification of each specific type of quadrilateral.

Extensions and Connections (for all students)

- Have students use constructions to create each type of quadrilateral: parallelogram, rectangle, rhombus, square, and trapezoid.
- Have students use constructions to create each type of triangle: scalene, isosceles, equilateral, right, acute, and obtuse.

Strategies for Differentiation

- Provide students with videos that demonstrate each type of construction.
- Provide students with detailed written instructions for each type of construction.
- Enlarge graph paper for the activity.
- Color code the different constructions within the quadrilaterals.
- Modify the student activity to use only specific constructions.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Verifying Properties of Quadrilaterals

A review of some or all constructions may be needed before completing this activity.

1. Using dynamic software or compass, ruler, and paper, construct a quadrilateral with vertices $A(-2, 1)$, $B(8, 5)$, $C(0, -7)$, and $D(10, -3)$.
 - a. Using congruent segment construction, determine:
 - i. if opposite sides are congruent
 - ii. if all sides are congruent
 - iii. if diagonals are congruent
 - iv. if diagonals bisect each other
 - b. Using parallel line construction, determine if opposite sides are parallel.
 - c. Using congruent angle construction, determine if opposite angles are congruent.
 - d. Using angle bisector construction, determine if diagonals bisect angles.
2. Complete the chart on the following page to record your constructions. Based upon your constructions, determine if Quadrilateral ABCD is a parallelogram, rectangle, rhombus, square, or trapezoid.
3. Using dynamic software or compass, ruler, and paper, construct a quadrilateral with vertices $R(2, 7)$, $S(6, 1)$, $T(2, -5)$, and $U(-2, 1)$.
 - a. Using congruent segment construction, determine:
 - i. if opposite sides are congruent
 - ii. if all sides are congruent
 - iii. if diagonals are congruent
 - iv. if diagonals bisect each other
 - b. Using parallel line construction, determine if opposite sides are parallel.
 - c. Using congruent angle construction, determine if opposite angles are congruent.
 - d. Using angle bisector construction, determine if diagonals bisect angles.
4. Complete the chart on the following page to record your constructions. Based upon your constructions, determine if Quadrilateral RSTU is a parallelogram, rectangle, rhombus, square, or trapezoid.

Construction Verification Worksheet

Quadrilateral ABCD

Congruent Segment Construction	Yes	No
Opposite sides congruent		
All sides congruent		
Diagonals congruent		
Diagonals bisect each other		
Parallel Line Construction		
Opposite sides parallel		
Congruent Angle Construction		
Opposite angles congruent		
Angle Bisector Construction		
Diagonals bisector opposite angles		

Based on the above construction verifications, Quadrilateral ABCD is a _____.

Quadrilateral RSTU

Congruent Segment Construction	Yes	No
Opposite sides congruent		
All sides congruent		
Diagonals congruent		
Diagonals bisect each other		
Parallel Line Construction		
Opposite sides parallel		
Congruent Angle Construction		
Opposite angles congruent		
Angle Bisector Construction		
Diagonals bisector opposite angles		

Based on the above construction verifications, Quadrilateral RSTU is a _____.