**Essential Question**
- How much do we need to know before we can start making assumptions?

**Objectives & the Common Core Standards**
G-GPE (4-7) Use coordinates to prove simple geometric theorems algebraically.
- Students will use coordinates to prove that a figure defined by four points in the coordinate plane is a special quadrilateral.
- Students will use the slope criteria for parallel and perpendicular lines to solve geometric problems.
- Students will use coordinates to find perimeters and areas of quadrilaterals.

7-G (6): Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.
- Students will solve mathematical problems involving area of two-dimensional objects composed of triangles and quadrilaterals.

**Teaching Notes**
The mysterious disappearance of Inspector Quadro leaves several case files incomplete and unsolved. Students are called upon to gather evidence to unmask the identity and area of the mysterious quadrilaterals.

This versatile activity includes seven ‘unsolved case files’ that are arranged in progressive order of difficulty and one template for you to add your own. It offers several options for differentiated instruction. It can be used:
- **As an individual in-class assessment.** Pick and choose the difficulty according to the class or individual students.
- **As a take-home project or assessment.** Assign all seven cases or allow students to choose. You can assign point values to encourage students to attempt more difficult cases.
- **As a group project.** Assign all cases to a group of 3 or 4 students. They can decide whether it’s best to divide and conquer or collaborate.

This activity is a cumulative assessment for a quadrilaterals unit. Students should already be comfortable with:
- Properties of Special Quadrilaterals (parallelogram, rectangle, square, rhombus, trapezoid, kite)
- Quadrilateral Theorems
- Coordinate Graphing
- Distance and Slope Formulas
- Slope Criteria for Parallel and Perpendicular Lines
Case #2:

ABCD is a quadrilateral with exactly one pair of parallel sides. The nonparallel sides (bases) are congruent. Therefore, ABCD is an isosceles trapezoid. (Definition of Isosceles Trapezoid)

• AB = 6 units long, with slope of 0
• BC = 5√5 units long, with slope of 11/2
• CD = 10 units long, with slope of 0
• DA = 5√5 units long, with slope of -11/2

Since parallel lines have same slope, AB ∥ CD and BC ∥ DA.

BC = DA

Area = 88 units²

Case #3:

ABCD is a parallelogram with four congruent sides and four right angles. (Definition of Square)

ABCD is a quadrilateral with four congruent sides and four right angles. (Square Corollary)

Therefore, ABCD is a square.

• AB = √(136) units long, with slope of -5/3
• BC = √(136) units long, with slope of 3/5
• CD = √(136) units long, with slope of -5/3
• DA = √(136) units long, with slope of 3/5

Since parallel lines have same slope, AB ∥ CD and BC ∥ DA.

Since perpendicular lines have slopes that are opposite reciprocals, AB ⊥ BC, BC ⊥ CD, CD ⊥ DA, DA ⊥ AB

AB = BC = CD = DA

Area = 136 units²

Case #4:

ABCD is a quadrilateral with no parallel sides and two pairs of consecutive congruent sides. (Definition of Kite)

Therefore, ABCD is a kite.

• AB = BC and CD = DA

AB = √65 units long, with slope of -1/8
BC = √65 units long, with slope of -8
CD = 7√(13) units long, with slope of -2/3
DA = 7√(13) units long, with slope of -3/2

Area = 154 units²
**Case #5:**

ABCD is a parallelogram with four congruent sides. (Definition of rhombus) or
ABCD is a quadrilateral with four congruent sides. (Rhombus Corollary) or
ABCD is a parallelogram with perpendicular diagonals. (Theorem 6.11)

Therefore, ABCD is a **rhombus**.

- AB = 10 units long, with slope of 3/4
- BC = 10 units long, with slope of −3/4
- CD = 10 units long, with slope of 3/4
- DA = 10 units long, with slope of −3/4

- Since parallel lines have same slope, AB || CD and BC || DA.
- AB = BC = CD = DA
- AC is horizontal and BD is vertical, so diagonals are perpendicular

**Area** = 96 units$^2$

**Case #6:**

ABCD is a quadrilateral with NO parallel sides and NO congruent sides.

Therefore, ABCD is an **quadrilateral with no special properties**.

- AB = 6 units long, with undefined slope
- BC = 13 units long, with slope of 5/12
- CD = √(146) units long, with slope of 11/5
- DA = 7 units long, with slope of 0

**Area** = 74.5 units$^2$

**Case #7:**

ABCD is a quadrilateral with two pairs of parallel sides. (Definition of Parallelogram) or
ABCD is a quadrilateral with two pairs of opposite congruent sides (Theorem 6.6)

Therefore, ABCD is a **parallelogram**.

- AB = 3√(13) units long, with slope of 2/3
- BC = 2√(34) units long, with slope of -3/5
- CD = 3√(13) units long, with slope of 2/3
- DA = 2√(34) units long, with slope of -3/5

- Since parallel lines have same slope, AB || CD and BC || DA.
- AB = CD and BC = DA

**Area** = 114 units$^2$
(must compose from rectangles and triangles, impossible to determine height)

**Case #8:**

ABCD is a quadrilateral with exactly one pair of parallel sides. (Definition of a Trapezoid)

Therefore, ABCD is a **trapezoid**.

- AB = 3√(13) units long, with slope of −3/2
- BC = 10 units long, with slope of 4/3
- CD = 2√(13) units long, with slope of −3/2
- DA = √(89) units long, with slope of 5/8

- Since parallel lines have same slope, AB || CD

**Area** = 85 units$^2$
(must compose from rectangles and triangles, impossible to determine height)
The Quadrilateral Detective

a Coordinate Geometry Assessment

Case #1

The locations:
A: (5, 8)
B: (5, -2)
C: (-5, -2)
D: (-5, 8)

The EVIDENCE:

AB = 10 units long with undefined slope
BC = 10 units long with slope of zero
CD = 10 units long with undefined slope
DA = 10 units long with slope of zero

AB = \sqrt{(5-5)^2 + (-2-8)^2}

Inspector Quadro has mysteriously disappeared!

Before his disappearance, he was only able to complete the first of the case files in this investigation. Foul play is suspected. Please expedite.

The area of this square is 100 units squared because each side is 10 units long.

\[ A = \frac{1}{2} \times 10 \times 10 \]

\[ A = 100 \text{ units}^2 \]

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CASE # 2

The locations:

A: (2, 10)
B: (-4, 10)
C: (-6, -1)
D: (4, -1)

The EVIDENCE:

Quadrilateral Identified:

Area: ______

The evidence:

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CASE # 3

The locations:

A: (-3, 5)
B: (-2, -5)
C: (3, 1)
D: (2, 11)

The EVIDENCE:

Quadrilateral Identified:

Area: ________

The evidence:
CASE # 4

The locations:

A: (1, -9)
B: (3, -10)
C: (3, -2)
D: (-13, 12)

The EVIDENCE:
CASE # 5

The locations:

A: (-10, -7)
B: (-2, -1)
C: (6, -7)
D: (-2, -13)

The EVIDENCE:

Quadrilateral Identified:

Area:

The evidence:
CASE # 6

The locations:

A: (1, 5)
B: (1, -1)
C: (-11, -6)
D: (-6, 5)

The EVIDENCE:

Quadrilateral Identified:

Area:

The evidence:
CASE # 7

The locations:

A: (-3, 5)  
B: (1, 11)  
C: (11, 5)  
D: (2, -1)

The EVIDENCE:

Quadrilateral Identified:

Area: 

The evidence:

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CASE # 8

The locations:

A: (-2, 3)
B: (4, -6)
C: (10, 2)
D: (6, 3)

The EVIDENCE:
CASE # ___

The locations:

A: (___, ___)
B: (___, ___)
C: (___, ___)
D: (___, ___)

The EVIDENCE:

Quadrilateral Identified:

Area: ____

The evidence:
The Quadrilateral Detective
a Coordinate Geometry Activity

- quadrilateral ABCD is correctly graphed (1 pt)
- quadrilateral ABCD is correctly identified (1 pt)
- a valid theorem is cited as support for identification (1 pt)
- evidence includes all necessary calculations and explanations (slope, distance, etc.) (2 pt)
- AREA of quadrilateral ABCD is correctly calculated (1 pt)
- thorough evidence is shown to justify area (2 pt)

CASE # = _____ points

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CASE # = ______ points

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