Proving Quadrilaterals in the Coordinate Plane **Name** _____

Standard: **G.CO.11** Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
Essential Question: How can I use the coordinate plane to investigate properties of quadrilaterals?

Distance d = $\sqrt{(y_1 - y_2)^2 + (x_1 - x_2)^2}$

Midpoint $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

Slope = m = $\frac{y_1-y_2}{x_1-x_2}$

A. **Plot points** A = (-3, -1), B = (-1, 2), C = (4, 2), and D = (2, -1).

1. What specialized geometric figure is quadrilateral ABCD? Support your answer mathematically by proving opposite sides are parallel.

2. Draw the diagonals of ABCD. Find the coordinates of the midpoint of each diagonal. What do you notice?
   - midpoint of $\overline{AC}$ = _____
   - midpoint of $\overline{BD}$ = _____

3. Find the slopes of the diagonals of ABCD. What do you notice?
   - slope of $\overline{AC}$ = _____
   - slope of $\overline{BD}$ = _____

4. The diagonals of ABCD create four small triangles. Are any of these triangles congruent to any of the others?

B. **Plot points** E = (1, 2), F = (2, 5), G = (4, 3) and H = (5, 6).

5. What specialized geometric figure is quadrilateral EFHG? Support your answer mathematically.

6. Draw the diagonals of EFHG. Find the coordinates of the midpoint of each diagonal. What do you notice?
   - midpoint of $\overline{EH}$ = _____
   - midpoint of $\overline{FG}$ = _____

7. Find the slopes of the diagonals of EFHG. What do you notice?
   - slope of $\overline{EH}$ = _____
   - slope of $\overline{FG}$ = _____

8. The diagonals of EFHG create four small triangles. Are any of these triangles congruent to any of the others?

C. Plot points P = (4, 1), W = (-2, 3), M = (2,-5), and K = (-6, -4).

9. What specialized geometric figure is quadrilateral PWKM? Support your answer mathematically.

10. Draw the diagonals of PWKM. Find the coordinates of the midpoint of each diagonal. What do you notice?
    - midpoint of $\overline{KP}$ = _____
    - midpoint of $\overline{WM}$ = _____

11. Find the lengths of the diagonals of PWKM. What do you notice?
    - $\overline{KP}$= _____
    - $\overline{WM}$= _____

12. Find the slopes of the diagonals of PWKM. What do you notice?
    - slope of $\overline{KP}$ = _____
    - slope of $\overline{WM}$ = _____

13. The diagonals of PWKM create four small triangles. Are any of these triangles congruent to any of the others?

D. Plot points A = (1, 0), B = (-1, 2), and C = (2, 5).

14. Find the coordinates of a fourth point D that would make a rectangle. Justify that it is a rectangle.

15. Find the coordinates of a fourth point D that would make it a parallelogram that is not also a rectangle. Justify that it is a parallelogram but it is not a rectangle.