Problem 1 – Properties of Parallelograms

We will begin this activity by looking at the definition of parallelogram and several properties of the parallelograms.

1. Define **Parallelogram**.

2. Parallelogram *QUAD* is shown on page 1.4. Drag point *Q* to two different positions and record the lengths of the segments in the table. Then, drag point *U* to two different positions and record the data in the same table.

Position	$\overline{QU}$	$\overline{UA}$	$\overline{AD}$	$\overline{DQ}$
1				
2				
3				
4				

3. What do you notice about the lengths of opposite sides of a parallelogram?

Angles of a polygon that share a side are consecutive angles. Angles that do not share a side are called opposite angles.

4. Parallelogram *QUAD* is shown again on page 1.8. Drag point *Q* to four different positions and record the measurement of the angles in the table.

Position	$\angle Q$	$\angle U$	$\angle A$	$\angle D$
1				
2				
3				
4				

5. What do you notice about consecutive angles of a parallelogram?

6. What do you notice about opposite angles of a parallelogram?

Problem 2 – Diagonals of Parallelograms

For this problem, we will look at the properties of the diagonals of parallelograms.

7. Parallelogram *QUAD* is shown on page 2.2. Record the lengths of each segment in row 1 of the table. Then, drag point *U* to three different positions. Record the data in rows 2, 3, and 4.

Position	$\overline{QR}$	$\overline{AR}$	$\overline{DR}$	$\overline{RU}$
1				
2				
3				
4				

8. What do you notice about the diagonals of the parallelogram?

Problem 3 – Proving Parallelograms

In this problem, we will explore various properties and see if they guarantee that a quadrilateral is a parallelogram.

On page 3.3 is a quadrilateral with a pair of opposite sides that is congruent ($\overline{EX}$ and $\overline{NT}$). You are given the lengths of $\overline{NE}$, $\overline{EX}$, $\overline{XT}$, and $\overline{NT}$. You are also given the slopes of $\overline{NE}$, $\overline{EX}$, $\overline{XT}$, and $\overline{NT}$. Try to form a quadrilateral that is not a parallelogram with both pairs of opposite sides congruent by moving point *X*.

9. Does having both pairs of opposite sides congruent guarantee that the quadrilateral is a parallelogram? Draw an example or counterexample.

On page 3.6, you are given one pair of opposite sides congruent ($\overline{AT}$ and $\overline{CS}$) and one pair of opposite sides parallel ($\overline{CA}$ and $\overline{ST}$). You are given the lengths of $\overline{AT}$ and $\overline{CS}$. You are also given the slopes of $\overline{CA}$ and $\overline{ST}$. Try to form a quadrilateral that is not a parallelogram by moving point *A*.

10. Does having one pair of opposite sides congruent and one pair of opposite sides parallel guarantee that the quadrilateral is a parallelogram? Draw an example or counterexample.

On page 3.9, you are given one pair of opposite sides parallel ($\overline{YR}$ and $\overline{OU}$) Try to form a quadrilateral with opposite angles congruent that is not a parallelogram by moving point *O*. You are given the slopes of $\overline{YR}$, $\overline{OU}$, $\overline{YO}$, and $\overline{RU}$.

11. Does having one pair of opposite sides parallel and one pair of opposite angles congruent guarantee that the quadrilateral is a parallelogram? Draw an example or counterexample.

Problem 4 – Extending the Properties

For this problem,

1) Create any quadrilateral on page 4.2 and name it *GEAR*.
2) Find the midpoint of each side.
3) Connect the midpoints to form a quadrilateral.

12. What type of quadrilateral is formed after you connected the midpoints of *GEAR*?

13. How can you prove what type of figure is created by connecting the midpoints?