Name: _____   Date: _____

Student Exploration: Special Parallelograms

Vocabulary: parallelogram, rectangle, rhombus, square

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
Jerry is building a gate like the one shown to the right.

1. Should the 4 diagonal boards (the X's) be longer than, shorter than, or

   the same length as the 5 horizontal boards? _____

2. Explain why the diagonal boards make this gate stronger. _____

   _____

   _____

Gizmo Warm-up
In the *Special Parallelograms* Gizmo, you can manipulate a dynamic **parallelogram** with various constraints. You can then name the figure, based on its side and angle measures.

1. Be sure **None** is chosen under **Condition**. Drag the vertices around. What do the marks on the sides of the figure tell you is always true about the opposite sides of a parallelogram?

   _____

2. Continue dragging the vertices to see more parallelograms.

   A. What seems to be true about the lengths of the opposite sides of the parallelograms?
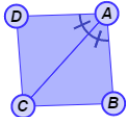
      _____

      Use the Gizmo rulers to verify this. (Select **Show ruler** to open a Gizmo ruler. Then, attach the "donuts" to points, as shown to the right.)
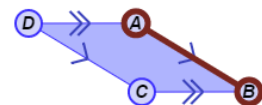
   B. What seems to be true about the opposite angle measures of the parallelograms?

      _____

      Use the Gizmo protractors to verify this. (Select **Show angle measure tool** to open a Gizmo protractor. Then, attach the "donuts" to points.)

Activity A:	Get the Gizmo ready:	
Parallelograms with conditions	• Be sure **Show shape name** is turned off. • Turn off any Gizmo rulers or protractors.	

1. Choose **All four sides are congruent**. Drag the vertices to see a variety of these shapes.

   A. What do you think a parallelogram with 4 congruent sides is called? _____

   Select **Show shape name** to verify your answer.

   B. Sketch a couple of examples of a **rhombus** in the space to the right.

2. Turn off **Show shape name**. Select **All four angles are right angles** from the **Condition** menu. Look at several of these shapes by dragging the vertices.

   A. What do you think the name of a parallelogram with 4 right angles is? _____

   Check by selecting **Show shape name**.

   B. In the space to the right, sketch two examples of a **rectangle**.

   C. Can a figure be both a rhombus and a rectangle? _____ Explain. _____

   _____

   A parallelogram that is a rectangle and a rhombus is called a **square**.

3. Select **One angle is a right angle**, and be sure **Show name of shape** is turned on. Experiment by dragging the vertices. Why must this parallelogram be a rectangle?

   _____

4. Turn off **Show name of shape**. Select **A diagonal bisects one angle**. Drag the vertices.

   A. What are these parallelograms – rhombuses, rectangles, or neither? _____

   B. Which two sides can you measure to verify? _____ Explain. _____

   _____

   _____

   Use the Gizmo rulers to measure the sides. Select **Show shape name** to verify this.

(Activity A continued on next page)

Activity A (continued from previous page)

5. Turn off **Show shape name**. Select **A diagonal bisects two angles**. Look at several of these shapes by dragging the vertices.

    A. Sketch an example of this parallelogram in the space to the right. Below, name the two pairs of congruent angles formed by the diagonal.

        _____

    B. Classify these parallelograms as rhombuses, rectangles, or neither. _____

        Click **Show shape name** to check.

6. Turn off **Show shape name**. Under **Condition**, select **Diagonals are perpendicular**. Drag the vertices to see a variety of parallelograms with perpendicular diagonals.

    A. Sketch an example of the figure to the right. Name the four right triangles formed by the diagonals.

        _____

    B. Are these four triangles congruent? _____ Explain. _____

        _____

    C. How can you use the four congruent triangles to determine the type of parallelogram

        formed? _____

        _____

        _____ Click **Show shape name** to check your answer.

7. Turn off **Show shape name**. Choose **Diagonals are congruent**. Create several parallelograms with congruent diagonals by dragging the vertices.

    A. What appears to be true about the angles of this parallelogram? _____
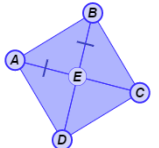
        _____ Use the Gizmo protractors to check.

    B. Continue dragging the vertices. What does this shape appear to be? _____

        Select **Show shape name** to check your answer.

    C. Do you think squares also have congruent diagonals? _____ Explain: _____

        _____

Activity B: **Using parallelograms**	Get the Gizmo ready: • Turn off **Show shape name**.	

1. Experiment with the Gizmo to help answer the questions below. Name the shape described, and explain your answers. Then check them by selecting **Show shape name** in the Gizmo.

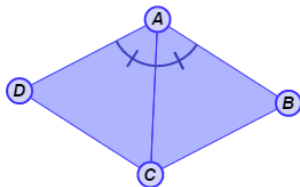   A. If a parallelogram has four congruent angles, then it is a _____

       Explain. _____

       _____

    B. If a parallelogram has a diagonal that bisects one angle, and is also congruent to the

       other diagonal, then it is a _____

       Explain. _____

       _____

2. Solve each problem. Show all of your work.

    A. In parallelogram *ABCD*, $\angle BAC$ and $\angle DAC$ are congruent, and $m\angle ABC = 54°$. What is $m\angle DAC$?

    B. In parallelogram *ABCD*, $\overline{AC} \cong \overline{BD}$. If $AC = 3x + 6$ and $BD = 5x - 8$, what is the value of *x*?