Name: _____   Date: _____
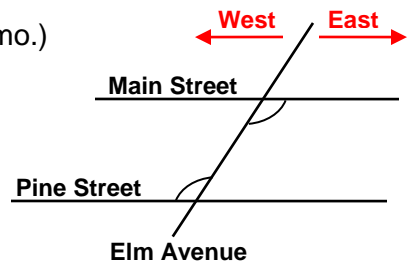
Student Exploration: Parallelogram Conditions

Vocabulary: parallelogram, trapezoid

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
Tricia is programming a "robot" car to travel from Main Street to
Pine Street. Main Street and Pine Street run exactly east-west.

1. Suppose the car is travelling due east on Main Street.

    A. Tricia gives it the command to "turn right by 110
        degrees" to turn onto Elm Avenue. What command
        will she need to give the car for it to turn on to Pine Street, heading due east again?

        _____

    B. What command will she need to give the car if she wants it to drive west (instead of

        east) when it reaches Pine Street? _____

2. On the map, Main Street and Pine Street are parallel, and Elm Avenue is a transversal that
   intersects both. What is the pair of angles marked on the map called?

    _____

Gizmo Warm-up
In the *Parallelogram Conditions* Gizmo, you can manipulate a dynamic quadrilateral with various
constraints. You can explore which constraints guarantee that the quadrilateral is a
parallelogram (a quadrilateral with two pairs of parallel sides).

1. Be sure **None** is chosen under **Condition**.
    Drag the vertices to create a quadrilateral
    that is *not* a parallelogram. Sketch your
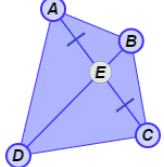   quadrilateral in the space to the right.

2. To open a Gizmo protractor, select **Show angle measure tool**. Measure
    an angle by attaching the "donuts" to three points, as shown to the right.
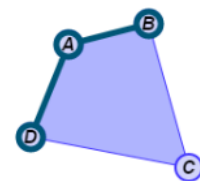
    Drag the vertices of *ABCD* around. Use the Gizmo protractor to measure
    all four angles of one of the quadrilaterals. What do the angles measure?

    $m\angle A =$ _____ $m\angle B =$ _____ $m\angle C =$ _____ $m\angle D =$ _____

Activity A: **Conditions that guarantee parallelograms**	Get the Gizmo ready: • Under **Condition**, select **One diagonal bisects the other**.	

1. With **One diagonal bisects the other** selected, drag the vertices of quadrilateral *ABCD*.

    A. Which diagonal bisects which? (Fill in the blanks.) _____ bisects _____

    B. Continue dragging vertices of *ABCD*. Do you think that a quadrilateral with one

        diagonal bisected by the other is guaranteed to be a parallelogram? _____

        Explain. _____

        _____

2. Select **Diagonals bisect each other**. Study the figure while you drag the vertices.

    A. Sketch one of the quadrilaterals
        in the space to the right.

    B. Use the Gizmo protractor to measure $\angle ACB$ and $\angle CAD$. What is true about these

        two angles? _____ In your sketch above, mark these

        angles with arcs.

    C. If $\angle ACB \cong \angle CAD$, what must be true about $\overline{AD}$ and $\overline{BC}$? _____

        Explain why. _____

        _____

    D. Which angles need to be congruent to prove that $\overline{AB} \parallel \overline{DC}$? _____

        Use the Gizmo protractors to measure the angles. Mark these angles in your sketch.

    E. Does having the diagonals bisect each other guarantee that a quadrilateral is a

        parallelogram? _____ Explain. _____

        _____

(Activity A continued on next page)

Activity A (continued from previous page)

3. Under **Condition**, select **One pair of opposite sides is ≅**. Drag the vertices of *ABCD*

   around. Does having one pair of opposite sides congruent guarantee that a quadrilateral is a

   parallelogram? _____ Explain. _____

   _____

4. Select **One pair of opposite sides is ||**. Experiment with the

   quadrilateral. Does having one pair of opposite sides parallel guarantee

   that a quadrilateral is a parallelogram? _____
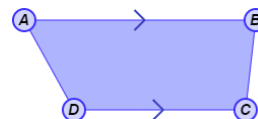
   Explain. _____

   A quadrilateral with exactly one pair of parallel sides is called a **trapezoid**.

5. Select **One pair of opposite sides is ≅ and ||** and **Show transversals**. Experiment by
   dragging the vertices around. Use the Gizmo protractor to measure the angles formed by
   the transversals and sides.

   A. Are *both* pairs of opposite sides parallel? _____ Explain. _____

   _____

   _____

   B. Drag the vertices of *ABCD* a bit more. Is a quadrilateral with one pair of opposite

   sides that are congruent and parallel guaranteed to be a parallelogram? _____

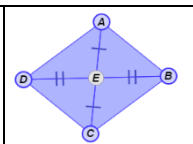6. Experiment with the Gizmo to help answer the questions below.

   A. If both pairs of opposite sides are congruent, does that guarantee that a quadrilateral

   is a parallelogram? _____ Explain. _____

   _____

   B. If both pairs of opposite angles are congruent, does that guarantee that a

   quadrilateral is a parallelogram? _____ Explain. _____

   _____

Activity B: **Using parallelograms**	Get the Gizmo ready: • Under **Condition**, select **None**.	

1. State whether each statement is always, sometimes, or never true. Then, explain your answer, and check it in the Gizmo.

   A. If one diagonal of a quadrilateral bisects the other, it is a parallelogram. _____

   _____

   B. If one pair of opposite sides of a quadrilateral is congruent, it is a parallelogram.

   _____

   _____

   C. Adjacent sides of a parallelogram are congruent. _____

   _____

2. Find the values of x and y that make each quadrilateral a parallelogram. Show your work.

   A.

   B.