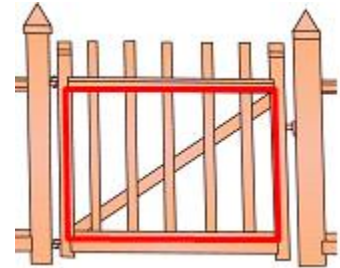Name: _____ Date: _____

Student Exploration: Distance Formula

Vocabulary: coordinates, distance formula, hypotenuse, Pythagorean Theorem

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

1. What type of figures does the diagonal divide the rectangle into?

   _____ _

2. The rectangle measures 3 feet by 4 feet. What is the length of the diagonal? _____

3. What did you use to find the length above? _____

Gizmo Warm-up
In the *Distance Formula* Gizmo™, you can drag points *A* and *B*
to change their **coordinates**, or (*x*, *y*) locations. Then you can
find the distance between the points.
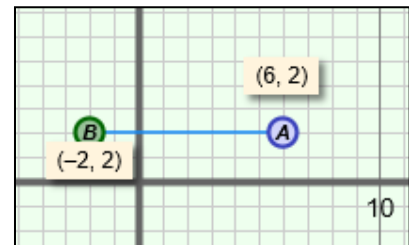
To begin, you will use coordinates to measure the distance
between points that are lined up horizontally and vertically.

1. With **Show values** selected, drag point *A* to (6, 2) and point *B* to (–2, 2) as shown above.

   A. What is the distance between the points? _____ Select **Show ruler**, and

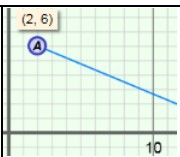   drag the "donuts" until they snap onto the endpoints to check.

   B. How can you use the *x*-coordinates (6 and –2) of the points to find this distance?

   _____

2. With point *A* still at (6, 2), drag point *B* to (6, –3).

   A. What is the distance between the points? _____ Use the ruler to check.

   B. How can you use the *y*-coordinates (2 and –3) of the points to find this distance?

   _____

Activity A: **Distance between two points**	Get the Gizmo ready: • Be sure **Show values** is turned on.	

1. Drag point *A* to (2, 6) and point *B* to (14, 1).

   A. Sketch the points and the segment between them on the grid to the right. Sketch segments to represent the horizontal and vertical distances between the points. Connect these segments to a third point *C*.
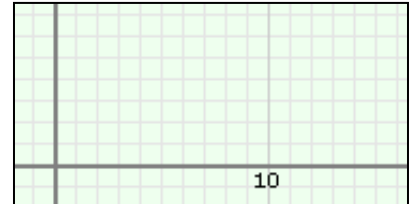
   What type of figure did you draw? _____

   B. For the figure you drew above, label the long leg *a*, the short leg *b*, and the hypotenuse *c*. (The labels *a*, *b*, and *c* represent the lengths of the sides.)

   What are *a* and *b*, the lengths of the legs?   *a* = _____   *b* = _____

   C. Use the **Pythagorean Theorem** ($a^2 + b^2 = c^2$) to find *c*, the length of the **hypotenuse** of the right triangle. Show your work in the space to the right. Use the Gizmo ruler to check your calculation.

2. Suppose the coordinates of point *A* are (x_1, y_1) and the coordinates of point *B* are (x_2, y_2).

   A. Fill in the blanks below to show how you can use these coordinates to find *a* and *b*.

   a = _____   *b* = _____

   Turn on **Show triangle** and select **Show labels** to check your answers.

   B. The Pythagorean Theorem can also be written $c^2 = a^2 + b^2$. Substitute the values you found for *a* and *b* above into this equation to write an expression for c^2 in terms of x_1, y_1, x_2, and y_2.

   c^2 = _____

   C. Substitute *d* (distance) for *c* (length of hypotenuse). Then solve for *d* by taking the square root of both sides.

   d = _____

   This is called the **distance formula**. Select **Show distance computation** to check your formula. Make corrections if necessary.

**(Activity A continued on next page)**

Activity A (continued from previous page)

3. Select **Show values** and turn off everything else.

   A. Drag point *A* to (–6, –5) and point *B* to (–1, 4). On the grid to the right, make a labeled sketch of the triangle that can be used to find the distance between the points.

   B. Use the distance formula, $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$, to find *AB*. Round to the nearest hundredth if necessary. Show your work in the space below.
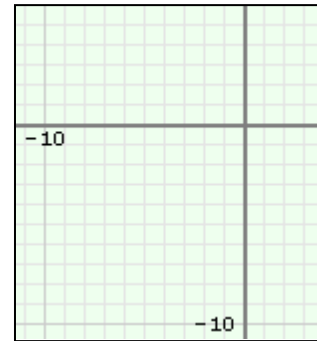
   C. Turn on **Show distance computation** to check your work above. Why is it *not* necessary to use the absolute value of the differences of the coordinates in the distance formula?
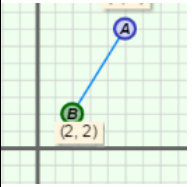
   _____

   _____

   D. Switch the order in which you subtract both coordinates in the distance formula. Do

   you get the same distance? _____ Why or why not? _____

   _____

4. Use the distance formula to find the distance between each pair of points. Round to the nearest hundredth if necessary. Write all your steps in the space below each problem. When possible, check your answers in the Gizmo. (The last one cannot be modeled in the Gizmo.)

   A. (–7, 9) and (3, –5)   B. (12, –8) and (–4, 1)   C. (–7, 5) and (–1, 16)

Activity B: **Using the distance formula**	<u>Get the Gizmo ready</u>: • Turn off everything except **Show values**.	

1. Lana and Tim live in a part of town where the streets form a grid. The general location of their houses is shown on the grid to the right. Each unit on the grid represents one mile.
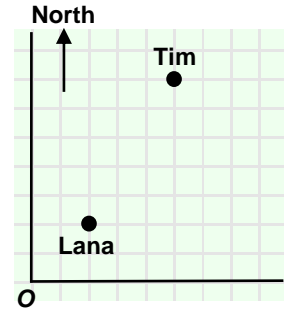
   A. Tim drives directly south, and then directly west to get to Lana's house. Sketch this path on the grid to the right. How many miles in each direction does he drive?

   _____

   B. What are the coordinates of each house?   Tim: _____   Lana: _____

   C. A crow flies along a straight line from Lana's house to Tim's house. Sketch a path on the grid above to show the crow's path. Then plot the points in the Gizmo (use point *A* for Tim and point *B* for Lana). Select **Show triangle** to check your work.

   What type of figure do all three paths make? _____

   D. Use the Pythagorean Theorem to find the distance the crow flies to the nearest hundredth. Show your work.

   E. Use the distance formula to find the distance the crow flies to the nearest hundredth. Show your work. Check your answer in the Gizmo.

   F. Which method do you find easier? _____   Why? _____

   _____

2. Suppose Lana can get to Carl's house by driving two miles north and two miles east. Use the distance formula to find the length of the straight path the crow flies from Carl's house to Tim's house to the nearest hundredth. Show your work in the space to the right. Then check your answer in the Gizmo.